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BY A COMMITTEE OF PRACTICAL SURVEYORS, ENGINEERS, AND ARCHITECTS, OF MUCH EXPERIENCE AND IN ACTIVE EMPLOYMENT

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PRACTICAL OBSERVATIONS ON CANAL WORKS.

THE age of canal-making has passed away in this country, and whenever it is sought in these days to establish a line of communication through a new district of country, the railway, with its engines of "fire and speed," has only to be named, to annihilate in one instant the pretensions of any rival project for internal communication. It is an effect due to that pitch of civilization at which Great Britain and some other countries have arrived, that when a great improvement like the railway system has been once introduced, and the demands of commerce, ever exacting and ever encroaching, have once been realized by the creation of a means of transit rapid beyond all previous conception, it is then an effect too natural to excite the least surprise, that the system once created must be maintained, and the superiority once acquired must be tenaciously kept up. On account also of that spirit of rivalry which prevails amongst European nations, the system of railways, although much more expensive than that of canals, will usurp the place of the latter, even in the most impoverished and least important states. But, although the construction of canals for purposes of traffic has thus to a great extent fallen off from the practice of engineers throughout Europe, and although modern engineers are not destined to reap the laurels with which such works as the Caledonian canal in our own country, and the Gotha canal in Sweden, have adorned the fame of Telford, we may yet look abroad to the colonies of Great Britain for a splendid field of engineering enterprize, where the construction of canals and the improvement of rivers for purposes of navigation will form, during many years to come, the most important part of the engineer's labours. Even in our own country, the annihilation of canal enterprise, strictly so called, has only interfered with their construction for purposes of internal trade and communication, and there yet remain a great variety of works in which the science of canal-making is highly necessary. Such are, the construction of canals for conveying water to supply towns, the diversion of rivers and water-courses for working mills and for ornamental purposes, and the excavation of great soakage drains and canals, rendered necessary in extensive projects for drainage. The following observations also, where they relate to puddling, and the construction of embankments for carrying water, will be found applicable to many engineering works where water is to be dealt with on an extensive scale, in lakes, rivers, and reservoirs, and we trust that their practical nature may compensate for any little irregularity in their arrangement.

Specifications for the construction of canals are usually framed somewhat in the following manner. After referring generally to the plans, sections, and other drawings, the specification goes on to describe the depth of water, the breadth of canal at bottom, height of bank above bottom, the ratio of slopes, and the breadth of towing-path and off-banks. It is then required that the canal shall be rendered water-tight by lining over all embankments with puddle, and the thickness of this lining is specified. Also, in all cuttings, whether deep or shallow, through open or unretentive strata, puddle is declared necessary, and the quality and thickness of it are described. Next, where the canal is carried through sideling ground, or such as presents an inclined surface at right angles to the canal, and where one side may happen to be in cutting and the other side is embanked; then, if the ground should be of an open nature, it is directed that, in order to render it water-tight, the whole of the bottom and sides shall be lined with puddle; but, on the other hand, should the soil prove to be a retentive material, it is simply required of the contractor to cut, on the lower side, a puddle gutter of a certain thickness, from which a puddle dam is to be raised through the bank, up to the level of top bank. Lastly, where the surface of water in the canal lies below the natural surface of the ground, and the bottom and sides of the excavation happen to be retentive, and capable of holding water, as a matter of course no puddle is required. The specification then refers to many other points, such as bridge-building, culverts, aqueducts, waste weirs, off-let pipes, trunks, locks, &c., all of which are described in detail, but which we shall not here more particularly allude to, as we purpose to confine ourselves to the method of constructing canal embankments, puddling, and excavations.

Figure 1 (*See the Plate*) shows the method of lining with puddle in a case where the depth of water is 4 feet, the width of canal at bottom 15 feet, the banks 5 feet above bottom, and the slopes 1½ to 1. From these data it will appear, that the width of canal at surface of water must be 27 feet, and at top bank 30 feet. Then, in order that a stratum of puddle 2 feet in thickness may be placed at the bottom of canal, it will be necessary in the first instance to excavate 2 feet deeper than the required depth when finished. A considerable additional width of excavation will also be necessary in order to admit the puddle, as shown by the figure. The engineer in such cases should specify the additional width and depth of cutting, which becomes necessary in consequence of the lining with puddle, and he may also state, for the information of the foreman or gangsman, the additional amount of cutting per foot or per yard running, which must be taken out to admit the puddle. This amount, where the surface of ground is not below the level of towing-path, will be 10¼ cube yards per yard forward; and although such information as this would not at all be necessary where the work is let to an intelligent contractor, who may have been accustomed for many years to the actual management and close superintendance of similar works, yet such points of detail will all be necessary for the engineer to attend to, if ever he should be called on to practise in this part of his profession in those distant rising colonies, where he will be thrown far more completely on his own resources than he could imagine possible, judging from what he sees in this country. To proceed then: in canals of this section it is considered expedient to construct the embankments of sufficient width to allow 7 or 8

feet for the off-banks, and 10 feet for the towing-path; but, in all cuttings, the width allowed for the towing path is 8 feet, and in all cases where the surface of the ground is at all above the level of the towing-path, a benching is preserved at this level on the opposite side of the canal. The principal object of this benching is to prevent loose stuff which might separate from the face of the slope above from falling into the canal: it is seldom made less than 4 feet wide, so that, however deep the excavation may be, the calculation previously given as to the extra cuttings necessary on account of the puddle will be found sufficient, because the width will not in any case be increased above the level of the benching. Whenever the top bank is raised above the surface of ground, the extra cutting for puddle will not be so great as we have stated. The other particulars connected with the puddling which we have not mentioned, such as the dimensions of the facing which is intended to secure the lining or puddle, and the width and slopes of the part excavated to admit the lining, will all be apparent in figures 1 and 2, from the latter of which it will be seen, that these particulars remain the same, however deep the cutting may be. We may here mention, that, although we have spoken of lining in deep cutting, it is in many cases not at all necessary, notwithstanding the frequently open nature of the strata through which the cutting is made. The expediency of puddling in deep cutting depends in fact upon the geological structure of the adjacent country, as determining the dip of the strata acoss the line of the canal. It is evident that in many cases, where permeable strata are intersected by the cutting, there would rather be a disposition for water to drain into the canal, than for the water already carried in the canal to pass off through the porous beds to some lower level than that of the canal itself. Now, wherever this disposition exists, the practice of lining or puddling would only entail an unnecessary expense. But, on the other hand, where springs or streams of water are observed at a lower level than the canal water, and not far from the line of the canal, this may be usually taken as an indication that lining is necessary to prevent the water of the canal from escaping to the natural outlets, which permit of its escape at a lower level than that of the canal.

With respect to the material proper for puddle, it is often found that, although a cutting may not produce any kind of stuff fit for the purpose without some sort of addition, yet it frequently happens that several materials may exist in a cutting, none of which, taken separately, can be used for puddling, but which, when mixed together, are admirably adapted for a lining to resist the penetration of water. For instance, neither sand, gravel, nor chalk, would, separately, form a good puddle, but at the same time the mixture of all or any of these, with even a very small portion of clay, may be worked into an excellent puddle. We have undertaken on more than one occasion to combat a very generally received opinion, that clay, unmixed with any other material, is the most suitable stuff for puddling, and our reasons, which, we should add, have been invariably confirmed by practice, may be briefly stated as follows: Where the clay is of a soft and soapy description, it is extremely apt to slip, and to be washed down by water; and if remarkably stiff and hard, the difficulty of working it into puddle is proportionably great. Hence, a great deal of skill and caution is necessary in forming puddles with this kind of clay; and after all the care that can be exercised, the liability of the puddle to crack is well known. The materials which unite well with clay in forming puddle are gravel, sand, and chalk; and a compound of all these constitutes an excellent grout puddle. Many other materials may also be used with advantage in the formation of puddle, such as peat, common mould, wood or coal ashes, brick-dust, &c., a description of which, with directions on the manner of mixing them, may probably form the subject of a future paper. It may be added, that excavations through rock or other strata, which are somewhat porous, have frequently been rendered water-tight by excavating the stuff 6 or 8 inches below the required depth, and filling this extra depth with sand, fine mould, horse-dung, wood or coal ashes, or a mixture of all or any of these materials with pounded lime. The water resting upon a bed of this kind, at first filters through it, carrying with it small particles, which in time choke up the natural crevices of the strata, and render the whole water-tight. The accompanying figures represent sections of a canal under the following different circumstances, namely:—

Fig. 1, is a section in 2 feet cutting, where the stuff is open or porous.

Fig. 2, shows open ground in deep cutting.

Fig. 3, is a section in 2 feet cutting, where the ground is retentive.

Fig. 4, is a section in deep cutting, also in retentive strata.

Fig. 5, is a section of the canal where passing through sideling ground of a retentive nature, one side of the canal resting upon an embankment, and the other side being the bed of an excavation.

Fig. 6, is a section of the canal in open ground, sideling as in the last section.

Fig. 7, is a section showing the lining necessary for embankments.

This latter being the most difficult case of execution in the earthwork of canals, it may be useful to point out, that the method usually pursued in raising the embankment is, to carry up the whole of the bank and lining at once to the height of 3 feet above the bottom of canal. A foot of soil must then be placed upon the puddle, to prevent it from drying and cracking, and the backing or solid stuff at the back of the lining will at that height be sufficiently wide to allow the earth waggons to travel upon it. Should there now be sufficient stuff in the cutting to complete the remaining part of the side banks, it should be worked *back-handed*—an expression which means that the stuff is to be conveyed first to the extreme end of the embankment, so that the distance between the cutting and the teaming place will be continually shortened, until at last the embankment will be brought into immediate contact with the cutting.

If, on the other hand, there should be a deficiency of stuff in the adjoining cutting to complete the banks, the method usually adopted is, to let enough water into the canal to float barges, by which the stuff is brought from the nearest cutting capable of supplying it, and is then readily deposited upon the base already formed to receive it. As, however, considerable detail is necessary to understand the manner of forming, and afterwards striking, the stanks, when they are no longer required, we shall not now attempt to enter more fully into this part of the subject, but reserve it for a future paper, which will contain more detail relating to the forming of canal banks, and the kind of boats best adapted for the purpose.

Although we are fully sensible of the serious obstacles which often oppose the practice of rendering the sides and bottoms of canals perfectly water-tight, we are far from admitting either the inutility or the impossibility of effecting this; and, with respect to

the latter point, we are firmly of opinion, that there is no case so difficult of execution, that the canal cannot be made to carry its required depth of water without leakage. As an example of a work where great difficulties were experienced in attaining this object, we have great pleasure in mentioning the Edinburgh and Glasgow Union canal, in Scotland, because it affords us an opportunity of alluding to the high talents and consummate knowledge of his profession, which distinguished the engineer of that work, the late lamented Hugh Baird. Dying at a comparatively early age, and practising at a time when the engineering arts were yet struggling for that rank which they were afterwards destined to occupy in the scale of the learned and scientific professions, Mr. Baird was still known to many of the most distinguished men of his own time, by whom his superior intellect could not fail to be highly appreciated. From all those who enjoyed the good fortune of his personal acquaintance and intimacy, and who were in any way connected with the works which he was called on to execute, he commanded the most enthusiastic respect and admiration, alike for the simple urbanity of his manners, and for the perfect mastery which he possessed over the most difficult details of the profession. The Union canal probably presented difficulties as complicated in effecting the tightness of its banks, as were ever concentrated in the execution of any similar work, as an example of which, may be taken the six miles of that canal extending within the county of Linlithgow, from the boundary between that county and Stirlingshire. The engineer had, in all cases of cutting through open or porous ground, specified that the bottom puddle was to be 2 feet in thickness, and for all embankments a puddle of 3 feet thick at bottom and sides was to be introduced; and these were in most cases found to be an ample provision. In a portion of the 6 miles alluded to, one side of the canal rested upon a solid base of trap rock, whilst the other was sustained by a rubble embankment, composed of the stone and loose stuff which had been blasted from the rock on the other side. Danger of leakage being apprehended here, it was determined to excavate 3 feet below the intended bed of canal, and to place a very perfect lining and puddle at the bottom and sides. This having been done, the place was deemed secure, and, during two or three months, betrayed no signs of danger; at the end of this time, however, and about the commencement of summer, the water began to escape at the side, and that part of the bottom which was formed of the loose stuff. The engineer was for some time at a loss to account for this defect, as he felt the utmost confidence both in the quality of the lining used, and in the skill and fidelity of those employed under him, to perform the work. Under these circumstances, it occurred to him that the winds, which prevailed with great force at the place in question, and the effect of which would be little diminished by the loose material of the embankment, acted so upon the puddle as to cause it to dry and crack, and thus render it incapable of retaining the water. Following up this supposition as to the cause of the mischief, he directed that the present lining should be removed from the embankment, and that a foot in depth of the loose stuff should be thrown out, so as to admit in the whole of 4 feet in depth of lining. It was then determined, that the outer foot in depth of this lining should consist of well pounded clay, which, being placed between the puddle and the loose rock, would, it was thought, prevent the former from being so injuriously acted on by the wind. This was accordingly done, and the puddle, being again well mixed, was replaced inside the pounded clay, and we believe that no leakage has ever occurred since the execution of this plan, about 20 years ago. Another instance of the success attending a similar application of pounded clay, occurred immediately at the back of the town of Linlithgow, where the canal is sustained across a deep valley, upon an embankment composed entirely of loose rock. The water was here retained at a depth of 3 feet for 3 or 4 months, and leakage then beginning to appear, it was in vain that the leaks were stopped up, the water always finding vent at some other part of the embankment; it was equally in vain that the water was drawn off, and the puddle remixed: the same evil always returned, until at length the water burst forth with such violence, as to carry away great part of an aqueduct near the town of Linlithgow, whilst the town itself, being in a lower situation than the canal, was in great danger of being inundated, much to the terror of its peaceful inhabitants. At last, the experience acquired at Kettlestone rocks, the site of the first experiment with the pounded clay, was put in practice; and the puddle being, as in that instance, protected with a coating of dry pounded clay with a mixture of mould, was here again found to hold the water with perfect success.

The following is a case of a different nature, and at the same time more difficult to deal with than the preceding. It is evident, that where a canal embankment is formed of a material which is uniform in its quality, there is little danger of one part of the lining separating from another, in consequence of the settlement of the bank, because the settlement will take place uniformly, and the whole mass will simply change its figure by passing into smaller dimensions. But if, on the other hand, one portion of an embankment be formed of a material which, like gravel, subsides very little, and soon acquires its least bulk, and adjoining parts consist of a material quite the opposite in this respect, it is evident that unequal settlement will take place, and the effect of this is to break up the puddle into irregular masses, so that, at the fissures thus formed, the bottom becomes quite leaky, and unfit to retain water. This action on the puddle, which is technically termed breaking its back, is somewhat analogous to the natural faults which prevail in stratified rocks, by means of which lower strata are thrown up along the line of fault, into contact with those which would occupy a superior place, if not disturbed by the fault. It is evident, that this system of faults in the puddle would destroy its capacity to hold water, and, accordingly, when a case of this kind occurred on the Union canal, it was found necessary to adopt the plan before alluded to, of filtering fine stuff into the cracks and crevices of the puddle. This was practised in the case of an embankment formed partly of clay and partly of shale, and, although clay subsides considerably, especially if embanked in deep lifts, and in a dry state yet many kinds of shale go into far less bulk, frequently losing 25 per cent. of their measurement in the cutting. This was the case in the present instance, and, in order to avert the danger which was threatened by the unequal settlement of the two kinds of stuff, an additional thickness of puddle was ordered for the bottom and sides of the canal. This, however, was found quite ineffectual, the settlement being so great as to break through the entire thickness of the puddle, and to cause the escape of the water. The plan of filtering was now resorted to, one foot of the top part of the puddle being taken off, and replaced by the same thickness of mould and fine sand mixed together. The effect of this was to choke up the cracks immediately after their occurrence, and the whole puddle being thus preserved in a sound state, notwithstanding the unequal settlement of the bank, all leakage was effectually prevented. We

would strongly recommend this expedient in all similar cases, where it becomes impossible or inconvenient to construct an embankment of the same material throughout; and it should be understood that the opinions here given, and the practices here advocated, are not theoretical, but, on the other hand, are entirely the result of actual practice and experience.

As the circumstances attending the execution of the Caledonian canal, and we may almost add, its failure with respect to its original object, have often been much misunderstood and misrepresented, it may be that a few observations on the subject of this work will not be quite uninteresting to the reader. Figure 8 shows the general dimensions of this canal, which was intended to float the largest class frigate, with all her stores, and the locks and bridges throughout were constructed of sufficient dimensions to admit this class of vessel. It has been said that there is not on earth a more leaky canal than the Caledonian, and this is certainly true enough with respect to that portion which lies between the Muirtown locks and the regulation lock at Dochgarroch. With the exception of about half a mile of clay cutting between Muirtown locks and the farm of Kimmylies, the whole of this part is exceedingly leaky, and along the side of the hill called Torr Vane, the canal is carried partly in cutting, and partly on embankment, through a material which, for its open nature, its loose structure, and unbinding qualities, cannot be surpassed, if, indeed, it has ever been equalled, by any stuff met with in canal works. It is, in fact, well described in the "Surveyor" of February last, in the course of a paper on the leakage of canals. The bed of the canal is here several feet above the river Ness, which winds its course along the base of the hill, and it cannot for a moment be supposed that the highly talented and experienced engineers, Messrs. Jessop and Telford, were not fully aware of the certainty of leakage at this part of the canal. Far from this, a considerable amount of leakage was fully anticipated, notwithstanding which, however, no lining was interposed between the canal and the river Ness, which they knew would receive the leakage water, without injury to the adjoining lands, and it was calculated that the great supply from the summit loch of Doughfour, and that called Loch Ness, would make up the deficiency. Hence no serious loss of water was apprehended, particularly as it was further imagined, that the smaller particles of sand and gravel would filter into the pores of the loose stuff, and eventually render this part of the canal water-tight. All who were interested in the credit of the work had soon, however, the mortification to learn the unsuccessful result attending this course, for no sooner were the paddles raised at Dochgarroch Lock, and the water admitted into this part of the canal, with a pressure of about 22 feet of water, than the alarming extent of the leakage became evident. So rapidly, indeed, did the water escape even when first admitted into the canal, that not a single drop ever reached the Muirtown Locks, and one of the contractors, who was waiting at an intermediate place on the canal banks, was in no small degree disappointed to find that the torrent of water, which he had expected to roll past him like the bore of some great tidal river, had dwindled into an insignificant ripple long ere it reached him, and that the bottom of the canal, for some distance towards the summit, was as dry as the top of the bank on which he stood. Finding that the canal would not hold water without some artificial expedient to retain it, a portion of the line passing through Donanchray Moor was divided off by a stank, and this part, being in deep cutting, was found to hold the water to a height of about 4 feet, when a constant supply was running in from the locks above. Barges were then introduced laden with many thousand tons of silty sand, a material admirably adapted for filtering, had the strata been such as to render this application successful. No sooner, however, was barge after barge-load of sand discharged into the canal, than it was carried by the water entirely through the pores of the loose stuff into the river, and after several days devoted to this discharge of sand, it was found that none remained but the coarsest parts of the gravel, and the water continued to escape as before. This expedient having totally failed, it was resolved to have recourse to lining along the part of the canal to which we have alluded. In the execution of this lining, as much of human skill and attention was displayed as could possibly be called into action, and yet it was not till after repeated failures that the canal was rendered capable of carrying even 12 feet of water, and, as far as we are aware, no greater depth has ever been obtained. Now the puddle lining at this part of the canal rests, as we have said, upon an extremely loose porous material, and we are desirous of referring attention to the examples we have cited from the Union canal, to show that a puddle in such a situation must be protected from the drying action of the wind, which will otherwise infallibly crack it, and destroy its capacity of holding water. We would therefore apply these observations to point out, as forcibly as possible, the certainty of failure in any future attempt to build upon the present puddle of the canal, in order to obtain a greater depth of water. All such attempts, we are convinced, from actual knowledge of the whole circumstances connected with the works, from the commencement till their completion, will prove an entire failure, unless effectual measures be adopted to secure the back of the puddle from the action of the weather.

H.

REPORT OF THE OFFICERS OF THE RAILWAY DEPARTMENT.

A FOLIO volume bearing this title has been presented, by command of Her Majesty, to both Houses of Parliament. The Report itself occupies 21 pages, and the Appendix 318; and in addition to this mass of information, a supplement has been issued, containing 11 plates, principally occupied with representations of the accidents which have occurred on railways during the past year. The first four pages of the Report contain an enumeration of accidents, from which "it appears, that the number of railway accidents of a public nature has considerably diminished, the last five months of the year 1840 showing 28 accidents, 22 deaths, and 131 cases of injury, while the twelve months of 1841 give only 29 accidents, 24 deaths, and 27 cases of injury."

The Report goes on to show that accidents occasioned by the misconduct of engine-drivers have also considerably diminished. From several examples of accidents in consequence of level crossings, the reporters express an opinion, that in all cases where railway companies are required to keep the gates shut across the railway, they should in future be required, instead of this, to keep them shut across the road. In pursuance of this opinion, we observe that Mr. Gladstone's Bill for the better regulation of railways, enacts that the gates shall in future be kept shut across the roads which intersect railways on a level, except where it is necessary to open such gates to allow carriages to pass the railway.

In page 10 of the Report is a table showing that the number of six and four-wheeled engines at present in use on railways, is of the former 605, and of the latter 224, and that, in the course of the last seventeen months, there have been three accidents, attended with personal injury, occasioned by engines running off the rails without meeting with any obstruction or other specific causes; in each of these accidents the engine has been four-wheeled. On this fact the Report makes the following comment, which is important as to the comparative safety of four and six-wheeled engines:—

"From the returns made by the different railway companies, it will appear that a very general opinion is entertained that four-wheeled engines are rather more unsteady and subject to oscillatory movements, and especially to vertical movements, which, in extreme cases, may lead to jumping off the rails, while on the other hand six-wheeled engines are thought to be less adapted for going round sharp curves, and if constructed with outside bearings, which are generally used with this description of engine, to be more liable to fracture their axles than four-wheeled engines with inside bearings. A reference to the table will show that experience does to a small extent bear out the opinion that four-wheeled engines are more liable to run off the rails, but, at the same time, it shows conclusively that no description of engine at present in use on railways can be pronounced dangerous, not a single accident having occurred in the course of seventeen months, which can be attributed solely to the construction of the engine, and only three in which the construction of the engine can be thought to have contributed even remotely to the accident." Several pages of the Report are then taken up with information as to the nature of the third-class traffic on railways, from which it appears that the accommodation afforded to the poorer classes by railways, in the manufacturing and densely populated districts of the north, is remarkably great, while in long lines, which form the main trunks of communication with the metropolis, and upon which there is a great through traffic, the number of third-class passengers is inconsiderable. In the manufacturing districts, therefore, third-class traffic is a source of profitable return; but with respect to the other lines, "it may be questionable," says the Report, "whether the interest of the proprietors will ever encourage the development of a large third-class traffic. It is satisfactory, however, to find that there is a growing disposition among railway companies thus circumstanced, to afford the accommodation of at least one train a day by which the poorer classes may be conveyed at reduced fares."

It appears that 179¾ miles of double railway, and 46 miles of single way, have been opened for traffic since the passing of the act for regulating railways, after having been inspected by the Board of Trade, since October 1840. Four pages of the Report are then occupied by a former report on the bye-laws, which every railway company is invariably empowered to make; but as this part of the subject is not much calculated to interest our readers, we omit any further allusion to it. The Report concludes by suggestions for further legislation on the subject of railways, but as most of these suggestions are embodied in the bill of the present session, which we shall notice in another place, it will be unnecessary to repeat them here. We quote, however, the last paragraph of the Report, as it contains the whole sum of the suggestions and precautions which the railway inspectors appear to think necessary in reference to that most serious class of accidents arising from the instability or inefficient execution of the works on railways, a source of accident which we venture to affirm will yet prove far more formidable than all that have yet happened. A singular apathy appears to prevail amongst those most interested in this important subject; with the fact plainly before their eyes, that many of the lines lately completed, and favourably reported on by the officers of the Board of Trade, are even now falling to pieces in every direction, it is perfectly astonishing to find that no intention is entertained by government of subjecting the works of all railways where danger is apprehended to a thorough and rigorous examination. We shall on a future occasion return to this subject; in the mean time the following is the conclusion of the Report:—

"The occurrence of so many slips during the present winter, upon lines which had been constructed for a considerable period, has shown that it would be desirable, in several cases, to give a greater width to embankments, and inclination to cuttings. A considerable obstacle is, however, presented to the adoption of these precautionary measures by the want of power to take the land requisite for the purpose. We would recommend, that in cases in which the Board of Trade shall certify that certain small portions of land adjoining a railway are required for the above purpose, the compulsory powers of taking land contained in the original act, should, as regards such portions of land, be revived. We should also recommend that, with a view to the speedy repair of slips and failures in the works of railways, railway companies should be allowed to enter upon and pass over adjoining lands for the purpose of repairing accidents, upon paying proper compensation to the owners of such lands for any damage done."

We now come to the Appendix, where we might expect to find much that will interest the engineer, as it contains the reports of the inspectors upon the various accidents which have occurred during the last year, and, of course, these reports will be applied to with much eagerness, in order to discover the views entertained by these highly responsible functionaries respecting the stability and security of the large works on railways. We do not purpose to make any comments upon the accidents arising from collision of trains, breakage of wheels or axles, or from trifling obstructions improperly lying on the rails; because, it being obviously the interest of every railway company to adopt the most judicious means for the avoidance of such accidents, and as at the same time these means may be adopted without any great pecuniary sacrifice, we venture to hold the opinion that such accidents do not require any thing so formidable as legislative interference; and we think the companies might very safely be permitted to alter or amend their own bye-laws as occasion may render necessary for the preservation of public safety. But, with respect to the condition of the great works, particularly the earth-works and tunnels on many of the principal lines, the case is widely different. Any change in the disposition of the slopes in deep cuttings and embankments, which a matured experience might prove necessary, would be attended with great expense; and it may well be that a board of railway directors, balancing on the one hand the contingency of occasional accidents against the expenditure absolutely necessary to alter the works so as to prevent such accidents, will hesitate to undertake measures so obviously unproductive (for a time at least) of that profit which is expected to result from every farthing of expended capital. Hence, can it be wondered at that they strongly contend for the perfection of their existing works, and deny that any general alteration is necessary in the mode of forming large excavations and embankments? It is obviously their

interest to keep at rest all inquiry on this subject, and marvellously well have they succeeded up to the present time; but sooner or later we may expect to see this important subject receiving its proper share of attention; certain we are that it deserves more consideration than any question involved in the engineering of railways, because, if the foundation on which the rails are placed be unsound, of what avail is the utmost skill and science displayed in the form and arrangement of the superstructure. If the slopes of those formidable cuttings, by means of which the railway penetrates the loftiest summits of country, be in so dangerous a state as to be liable at any moment to block up the narrow chasm in which the locomotive pursues its rapid course, and in one way or other suddenly to throw the whole train into one mingled ruin of broken pieces of machinery and bruised and shattered human limbs, of what value is it, where such dangers are threatened to be blessed with the otherwise inestimable privilege of "half annihilating time and space?"

The whole system is evidently imperfect unless the public be fully satisfied that the works of all railways are in a thoroughly sound, secure state, and this can never be the case till an examination shall be made by men every way qualified to pronounce on the execution of such works, and the precautions which such an examination shall call for have been duly attended to, no matter what the expense they may occasion. There are three accidents arising from instability of the works, which we shall remark upon, as affording some information relative to this important subject. These are, the accident of the 7th September, on the Great Western line, that of the 2nd October on the London and Brighton, by which four persons were killed and two injured, and that of the 24th December on the Great Western, by which nine were killed and twelve injured. In addition to these, there are several other accidents of the same nature not reported on in the present Appendix, we presume because they happened before the date of the last general report. The first of the three accidents mentioned above happened on the Great Western Railway, owing to a sudden slip of the embankment on the incline between Wootton Bassett and Chippenham, about 86 miles from London. It is singular that the second sentence of Sir F. Smith's report on this accident states that the number of persons injured was four or five, in addition to two servants of the company, whilst in the general table of accidents, in the third page of the Report, the whole number said to be injured by this accident is one person; and the nature of the accident itself is expressed by the words, "train off the line." We cannot pretend to wade through the whole of this voluminous Report and Appendix, collating one part with another in order to test the accuracy of the returns, but we certainly cannot help noticing this remarkable disagreement in the description of the very first accident which came under our notice. The erroneous statement of the number of persons injured, which is made in the general list, is obviously calculated to mislead, because the total number of accidents is made use of by way of comparison with those of last year, in order to show the effectual good produced by the supervision of the Board of Trade; and if the return from which the comparative numbers of accidents are obtained be incorrect, of what value is this comparison, and to what useful end is it made. But we have still more to complain of in the description of the nature of this accident. It is true enough that the train was off the line. But what caused the train to go off the line? This is what the public is most interested in knowing. The expression, "train off the line" will apply to almost any accident that may happen on a railway. Is a train suddenly stopped by collision, either with another train or with a slip of earth?—the engine and some of the carriages probably jump off the rail, and yet to say "train off the line" does not relate the nature of the accident. Does a sudden slip of an embankment precipitate an engine and train from a height of 40 or 50 feet, an accident of which it is impossible to say that it may not happen more than once before the safety of railway travelling is established?—it is true enough the unfortunate train would be off the line, and far enough from it, too, but this is only an effect of the accident, not its cause, and does not express its nature. We trust that in all future returns from the Board of Trade the real cause of an accident will be described, no matter what discredit the avowal may reflect upon persons, of whose reputation it may be politic to be cautious. Turning to this particular accident on the Great Western, we would ask why is it not described in the same words as other accidents of a similar nature. For instance, that of the 24th December, on the same railway, is thus described: "slip of earth suddenly stopping the train;" and one on the Birmingham and Gloucester, of the 20th January, 1841, is called "train off the line owing to a slip of earth." It would at least have been fair, in the accident of the 7th September, and some other cases, to add the same important words, "owing to a slip of earth;" but, as it is at present, the public, by reading over the list of accidents, formidable as they are, is by no means aware how many of these are attributable to the instability and defective state of the works on some of the most important lines. We should be extremely sorry to impute the least appearance of trickery or design to deceive to any of the highly respectable parties whose names are affixed to the general Report, but we do trust that in future the returns of accidents which they lay before the head of their department will be free from such irregularity and omissions as we have here pointed out. We have said, that our time and space will not suffice for a detailed examination into all the accidents, but we do hope that, if the case were otherwise, we should find no more of such instances as we have already felt ourselves called on to complain of.

Sir Frederick Smith, in his account of this accident of the 7th September, states, "that one passenger was very seriously, and three or four others less severely injured, and two servants of the Company slightly hurt." The cause of the accident may be gathered from the following sentence of the Report: "As soon as the carriages were stopped, and the passengers had received the attention they required, the drivers and conductors of the train examined the ground, and discovered that there had been a slight slip of the embankment, and that some of the longitudinal timbers of the north line had sunk about three or four inches below the level of those on the opposite line, at the spot where the engine quitted the rails." We fully concur in the opinion of Sir F. Smith, that no blame is attributable to any of the servants of the company; but, in order to show the necessity of minutely watching such embankments as the one in question, we shall just state a few particulars from the Report itself.

In the first place, the accident happened on an embankment which is composed of a material very unfavourable for such a formation, and which has "occasionally slipped in various places, and amongst others, a slip occurred some time ago at the point where the accident now under consideration has taken place." The next important fact we would insist on, is, the almost miraculous escape

which the public safety has experienced, for it is impossible to doubt that, according to all human probability, such another accident happening under similar circumstances, with only a very trifling variety, will be productive of consequences ten times more serious. The first fortunate circumstance here is, that the train consisted of only three carriages, and the second is, that the carriages which ran off the rails, did not take a direction towards the outside of the embankment, but turned towards the other line of way, breaking the transoms which connect the north and south lines of the longitudinal timbers. "It was a piece of great good fortune," says Sir Frederick Smith, "that they passed between these lines, for had they taken the opposite direction, they would in all probability have gone over the embankment." The chances of the two events were obviously equal, and it was clearly by the merest accident in the world that the train continued on the top of the embankment, instead of being dashed from the top to the bottom of it into one mingled heap of ruin and destruction. We have stated the number who were actually injured under the very favourable circumstances which characterized the accident happening to a train of only three carriages. Our readers may judge from this, what might have been the consequences to a full train hurled pell-mell from the height of an embankment equal to about thirty feet in the deepest part, though only about sixteen where the accident actually took place.

The next accident we have proposed to notice is, that of the 2nd October, at Hayward Heath, on the London and Brighton Railway. Professor Barlow was appointed to report on this accident, and it seems that fortune, taking advantage of the proximity of so high an authority to another dangerous part of the same railway, enabled him to kill two birds with one stone, for it actually happened, that when the learned Professor was on his way from Brighton to visit the first accident, a second occurred at the Patcham tunnel, which prevented his further progress on the line. His report, therefore, is quaintly enough styled, "On the Accident of the 2nd instant; also on the falling in of the Patcham Tunnel." We shall first endeavour to explain, from the description given by Professor Barlow, the nature of the obstruction which threw the train off the line at Hayward Heath, and which occasioned what may be termed the original accident. It seems that the place where it occurred is about 36¼ miles from London, about a mile north, or on the London side, of the Hayward Heath Tunnel. "The soil in this cutting," says Professor Barlow, "and for some distance down the line, is of a very absorbent and treacherous character, becoming in its wet state nearly semi-fluid, and yet when dry or well-drained it appears perfectly sound; and I am bound to state that I stood at this place and observed trains passing with considerable speed both up and down the line, and that their motion was exceedingly steady, that is, free from rocking, which is generally so obvious where a line is defective." Here it seems is a suspicion expressed, that when water is allowed to get under the bed of the railway at this cutting, it produces an unsoundness and an irregular capacity of resistance in the soil, which would be indicated by an oscillatory motion of a train passing through it. The Professor continues, "I have watched this effect, and have experimented upon it on several lines, and I am not aware that I ever saw less oscillatory motion. But it must be observed, that at this time every thing that could be done had been done to carry off the water. For a day or two before the accident the rain had been very heavy, and I have no doubt, from the nature of the soil, and the evidence of Copley, that the road was at the time in what he describes as 'a light state,' which he afterwards explained by saying,—*When there is much rain the wet pushes up the rails and makes them uneven, but that was not the case on Saturday.*" It will appear from what follows that the Professor, and with much reason, entertained a very strong opinion, notwithstanding the assurance of Mr. Copley to the contrary, that this just *was* the case on Saturday. The Report continues, "I asked him 'If the road was not in that state on Saturday, and the speed not greater than usual, why he gave the signal?' but all that I could learn was, they had done so for two or three days." Professor Barlow now comes to the following conclusion, which contains the real gist of the matter, and explains what we are bound to consider as the real cause of the accident. "Weighing these circumstances, viz., the nature of the soil, the great quantity of rain that had fallen, the admission that a caution signal was made, and had been made for some days before, I feel no doubt whatever that the unsound bearing of some one or more of these sleepers at the time was one cause of the accident." No one has any right to complain of the cautious and diffident manner in which this opinion is expressed. The Professor, it should be observed, does not say *the* cause, but *one* cause of the accident. To any one, however, who is at all acquainted with the consequences of water penetrating a tough spongy material like the bed of this cutting, there can be very little doubt that the unsound bearing of the sleepers was in reality the principal cause. Hence, then, we are compelled to view the mischief here occasioned under the same general head of instability in the works which has been in some other cases more directly productive of injury to public safety. It is scarcely necessary to observe that a thorough system of drainage would effectually keep the cutting dry, and then there would be nothing to counteract that regularity in the motion of the train which was observed by Professor Barlow when the cutting was perfectly dry. We have not a single word to say by way of reflection upon the management of this particular railway. The details of the preceding accident are only given to show the necessity for a general system of practical treatment, calculated to protect the earth-works of railways from the injurious effects of water, which, in almost every case of instability, is found to be the agent effecting it.

It seems that the coroner's jury on the occasion of this accident, at Hayward Heath, attached some blame to the 4-wheeled engine, which happened to be drawing the train at the time in question; Professor Barlow, however, is of opinion that the 4-wheeled engines are equally safe with those on six wheels.

The second accident, namely, the falling in of the Patcham tunnel, which Professor Barlow was so opportunely enabled to report on at the same time, was occupied by water penetrating the backing, and causing it to press with so great a force upon the tunnel front, as first to fracture it, and at last to occasion its fall. Our space is insufficient for a minute review of the causes of this failure in the work, which it is satisfactory to learn was not attended with any personal injury, although, had it happened in the night, the consequences of the obstruction which the stone or brick work of a tunnel front falling on the rails would occasion, may be readily enough imagined.

We now come to the crowning accident of the last year, the one which, in its serious consequences, threw all the former into the shade. The numbers of killed and wounded, as stated by Sir F. Smith, differ from those in the general statement of accidents, from

which it appears that 9 were killed, and 8 wounded, whereas Sir Frederick states that 8 were killed and 17 wounded. This accident, it is well known, took place in the Sunning Hill, between Twyford and Reading, where the line is carried in a cutting "through a clay and gravelly formation of 1¼ of a mile in length, and of the extreme depth of 60 feet." The accident was occasioned by a slip of earth which fell from the slope of this cutting upon the rails, and caused a sudden stoppage of the train. The goods waggons which were placed at the end of the train, retaining their impetus, then ran forward upon the two passenger carriages, throwing them both completely off the rails, and producing, by the violent concussion, the lamentable injury and loss of life mentioned above. The guards, on jumping from their seats, found, by the aid of their lights, "that the cause of the accident was a heavy slip from the slope of the cutting adjoining their line, which had covered the rails to the depth of nearly 4 feet. It was found that the concussion had thrown the whole of the passengers out of the carriages." On first observing the slip called a heavy one, and further on in the Report seeing it called "this extensive slip," we felt considerable surprise, because several accounts we have received from eye-witnesses accustomed to observe works of this kind, agreed in stating that the slip was very inconsiderable, and we have been assured that, had it not been for several lumps of septaria which had fallen on the rails, the wheels of the engine and carriages would have cut through the obstruction, and no injury of consequence have been sustained. This, too, we should observe, is the opinion of Mr. Brunel, as expressed on the inquest. Considering these contradictory statements, we repaired with some curiosity to the section of the slip drawn to a scale, which appears in the supplement to the Report. Now the sectional area of the slip measured from this view of it, is 45 square yards, and, taking the length of the slip at 30 yards, as stated by Sir F. Smith, the whole mass of this *extensive* slip will be something less than 1350 cube yards, because, of course, the section which shows the greatest hollow caused by the slip, does not extend the whole length of the 30 yards, but falls off towards each boundary of the slip. Now there is nothing in this amount of little more than 1,000 cube yards, to convey the idea of a heavy slip, or an extensive slip, particularly when we contrast them with the slips which have come down on the Croydon railway, to say nothing of natural slips, which often contain millions of cube yards of earth. The fact is, there could scarcely be imagined a smaller slip producing such a disastrous effect upon a train coming in contact with it, and it is clear that, if such small slips as the one in question are capable of working so much mischief, the necessity of guarding against all slips is so much the greater. Sir F. Smith, after stating that the depth of cutting where the slip took place is 58 feet, and that the slopes are 2 to 1, expresses his opinion that this slope is quite sufficient. The following are the words of the Report: "I do not imagine that any engineer would have thought it necessary to give the sides of this cutting a greater slope than 2 to 1, and therefore there has been, in my opinion, no error in the construction; but it is a question whether the large mass of 'spoil,' resting on the natural ground adjoining the edge of the cutting, did not mainly cause, or at least greatly contributed to increase, the extent of this extensive slip." In this opinion as to the sufficiency of the slopes, most engineers will now coincide, because a slip is just as likely to take place on a slope of 4 to 1, as on one of half the inclination. In fact, it is not, in the generality of cases, nor was it in this particular one, the ground behind the slope which gave way to any extent, but merely a hollowing out of the face of the slope, which is obviously almost independent of the angle at which it is cut back. But, although the slope may be quite sufficient, supposing it to be quite assumed that the cutting should, under all circumstances, have been executed with one uniform slope from top to bottom, yet a most important consideration devolves upon this exception.

In a former paper on the causes and prevention of slips of earth, we have shown sections of cuttings executed with short slopes alternating with benches, and we hope yet to prove to the satisfaction of those most interested, that this system of disposing the sides of deep excavations must, in future, be adopted in preference to the common practice of uniform sloping.

In Sir F. Smith's report on this accident, the principal suggestions which we observe, in reference to the future safety of the passengers, relate to the use of spring buffers, which he recommends for all passenger carriages, and to the necessity of greater height in the sides and ends of third-class carriages. Now these things are all very proper and prudent, and so no doubt is the use of reflector white lamps on the buffer beam, which the Report also recommends; but none of these will prevent slips of earth; the most they can do, if acted upon in every respect according to the full intention of the inspector-general, is to break, in some degree, the force of collision, whenever the progress of a train is opposed by an obstruction like the one in question. Then, do we understand, from the systematic coolness with which everything like prevention of the *obstructions* themselves is overlooked, that we are to sit down contentedly, with the assurance that slips of earth cannot be prevented, but that railways must be allowed to tumble to pieces whenever they please, particularly in rainy weather, when it seems, not only from the present Report, but from several other reports on other accidents, that slips are to be anticipated quite as a matter of course? Is it possible that no idea is entertained by the officers appointed to inspect railways, that something *must be done*, ay, and quickly too, not only to prevent injury from collision, but to prevent collision itself? The lives of the public are not to be placed at the mercy of an engine driver's eye discovering what would appear to him a mere speck on the surface of the rails—they are not to depend upon the correct action of a buffer spring, nor can we consent for a moment to incur the terrific force of a collision, because we are told that the sides of the carriage are high enough to prevent us from being whirled out of it with the force and velocity of a cannon ball. How infinitely more satisfactory would it be, to remove the causes, and to lessen the chances of collision altogether!

We feel convinced, that if the railway inspectors have not at present the power to appoint a competent staff of practical engineers to examine the works of all railways, such powers must be extended to them by the Board of Trade, and if the Board of Trade be not empowered under any of their acts for the regulation of railways, to incur the expenses of such an examination, then Parliament must and will interfere, and supply this obvious deficiency in railway legislation. We have already pointed out the reason why companies cannot be expected to undertake any great alteration in the disposition of earth-works, and particularly any alteration in the construction of the slopes.

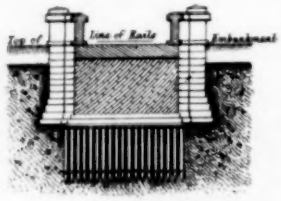
The disinclination of companies, however, to execute improvements which are absolutely necessary for public safety, is not for one instant to be regarded. Parliament will undoubtedly answer

OBLIQUE BRIDGE OVER THE RIVER GAUNLESS ON THE HAGGER LEAZES BRANCH RAILWAY,

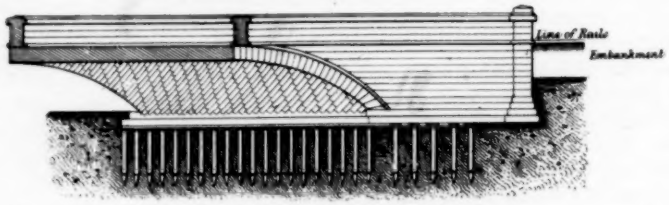
From the Stockton & Darlington Railway

Erected 1830.

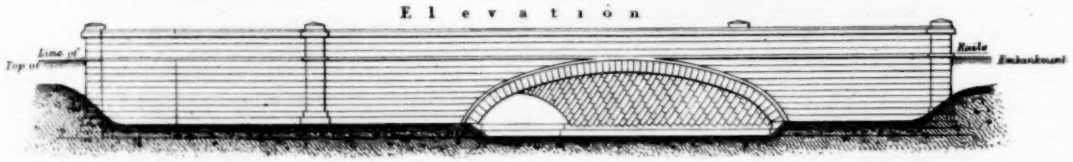
Transverse Section at A A on Plan



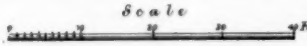
Oblique Section at B B on Plan



Elevation



Scale



Plan

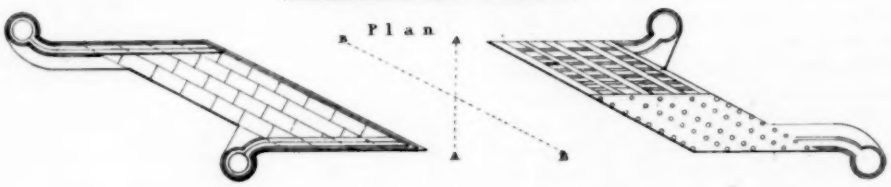


Fig. 1.

Plan of Part of
SCARBOROUGH HARBOUR.

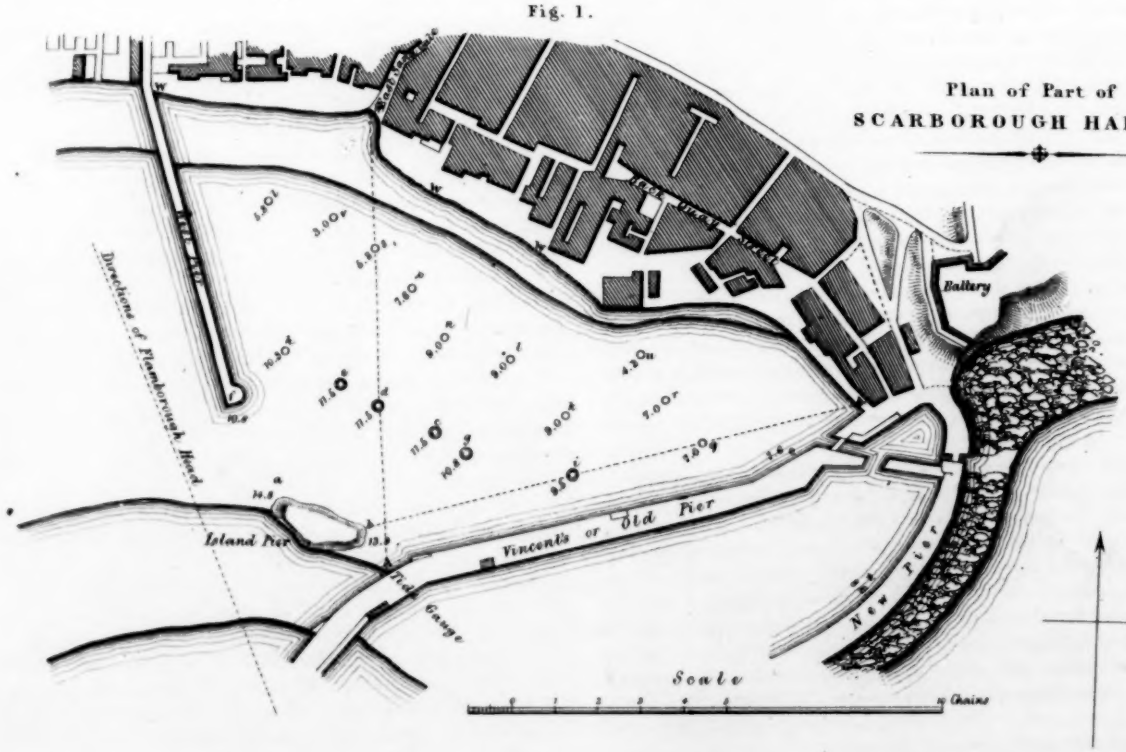


Fig. 2.

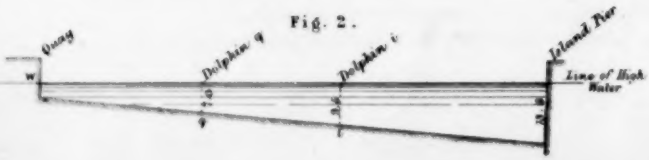


Fig. 3

Published by J. Weale Architectural Library 59, High Holborn.

J.B. Jobbins, J. Norwich Sc.

at once, "You have been invested with great and arbitrary powers in your railway acts; you have been empowered to make these works for your own private gain, and if you have chosen to make them inadequate to ensure the public safety, you must amend your errors, whatever be the sacrifice, or shut up your railways altogether."

It must not be imagined, because the three accidents which we have here commented upon are the principal ones in which injury to the public was sustained through the instability of the works, that these afford anything like an idea of the defective state of railways generally throughout the kingdom. Had it been our wish to excite alarms in the public mind, and to raise an indignant outcry against the neglect and apathy which prevail in a subject of so much importance, we should have quoted from Sir F. Smith's report on the Merstham cutting, London and Brighton Railway, in his journey to visit which cutting he observed, and in his report remarks on, the dangerous state of the Godstone road embankment on the same line, and also on the heavy slips on the Croydon Railway inclined plane, at New Cross. A great mass of information relative to slips of earthwork is contained farther on, in the Appendix, under the head of "Reports relating to the opening of new lines." Thus the opening of the Great Western Railway, between the Wooton Basset road and Chippenham, has been much delayed, owing to the slipping of embankments. The same remark applies to that part of the Cheltenham and Great Western Union Railway, between Cirencester and Swindon, where Sir F. Smith speaks of an embankment near the Swindon Junction, which has subsided to the amount of 8 feet in 24 hours. Sir F. Smith's report of 3rd November, on the Brighton railway, describes no less than six embankments which have been weakened by slips, and which are consequently in a dangerous state, as further slips and subsidings are to be expected. The report on the Sheffield and Manchester line, dated November 10th, refers to several dangerous places on that line, particularly one embankment 45 feet high, which has spread out at the base to two or three times its original width. In addition to these, there is the Gosport branch of the South Western Railway, where the works are in such a state that it was necessary entirely to close the line after it had been opened for public traffic.

The remainder of the Appendix, which we have not time to notice at length this month, contains correspondence relating to accidents, which is unimportant, because the accidents are given in a general table—Returns relating to level crossings—opening of new lines—returns relating to locomotive engines; these are answers to inquiries directed by the Board of Trade to the secretary of every railway company in the kingdom, about the dimensions of the engines used on their respective lines, the number of 4 and 6-wheeled engines, the names of their makers, and as to the mode in which extra engines are employed, and whether the tenders are ever allowed to run foremost—Returns relating to third-class passengers—bye-laws, rules, orders, &c.—enforcement of provisions of railway acts—returns made to the committee of Privy Council for Trade of the aggregate traffic in passengers, cattle, and goods upon railways; this is an important table, and will prove highly useful, in a statistical point of view, to the projectors of future lines. The Appendix concludes with regulations of the Leipsic and Dresden Railway; we presume these are introduced by way of comparison with the regulations prevailing on our own lines. They appear, from a cursory glance, to be very judicious, but we have not space to make a detailed review of them.

H.

MARITIME SURVEYING.

To find what depth of water there will be upon certain points or places in dry harbours on the full rise of tide, can be done with a greater degree of accuracy than can be obtained by soundings, and admits of extensive application, and will be found serviceable in readily ascertaining the state of such harbours; and also in rivers on all such places as may lie above the level of low-water mark. In examining these harbours for the purpose of improvement (such as the removal of sand banks, and to ascertain the height of those sand banks above a certain datum line,) fix upon as many proper points as may be thought necessary; then by laying down corresponding marks upon your plan, with numbers or letters attached thereto, either in pencil or coloured inks, by this arrangement very accurate longitudinal and transverse sections can be made, if necessary, with such facility and correctness as few people would conceive possible, and these operations may be carried to almost any extent. I think it would be unnecessary to proceed further in the detail of the subject, for those in the slightest degree conversant with such matters will readily perceive the object in view; and shall therefore proceed to give the necessary instructions.

Place on a flowing tide some person or persons you can depend upon, with a watch set exactly with your own; and give him a paper on which he shall set down the precise depth of water shown on the tide gauge at every ten minutes of the hour he is attending, or say every five minutes, as that will keep him more upon the alert, and you must notice the precise time by your watch that the tide arrives at any of the marks you have made on the pier, quay, shore, or sands, or at the foot of the dolphins or mooring posts: then by looking in the Table kept by your assistant, you will ascertain the depth of water on the tide gauge at the precise time the tid reached each of your marks.

REFERENCES TO THE PLATE.

Fig. 1. Plan of Part of Scarborough Harbour.

The Dolphins and the Figures on the lower sides denote the depth of water in feet and inches, in an eighteen-feet spring tide.

Scale, 4 chains to an inch.

Fig. 2. Longitudinal section from W at the Infirmary Bath Quay, across the two Dolphins *q* and *i*, to *b* on the east end of the Island Pier.

At W, depth of water here (supposed) 4 feet 6, and height of quay above this mark 3 feet; from this mark to the Dolphin at *q*, distance 370, depth 7 feet; to the Dolphin at *i*, distance 690, depth 9 feet 5 inches; to the Island pier at *b*, distance 1160, depth 13 feet 9 inches.

Fig. 3. Cross section of the Harbour from East-sand gate, across the two Dolphins *s* and *d*, to A, the tide gauge on Vincent's Pier.

From W to the Dolphin at *s*, 310, depth 5 feet 8 inches; to the Dolphin at *d*, 680, depth 11 feet 5 inches; and to the tide gauge A at Vincent's Pier 1080, depth 18 feet.

Longitudinal scale, 4 chains per inch.
Vertical scale 40 feet per inch.

TABLE, No. I.

Showing the progressive rise of tide at every five minutes of time.

The flood tide reached the foot, or the zero mark of the tide gauge (A) on the Vincent or Old Pier, at half past ten, and continued to rise until twenty minutes past three.—Full moon this morning at half past eight o'clock, the weather remarkably fine, and the sea quite calm.

Minutes.		Feet	In.	Minutes.		Feet	In.	Minutes.		Feet	In.
	Half-past Ten			15	Past Twelve	6	7	5	Past Two	14	9
25	To Eleven	0	6	20	" "	7	0	10	" "	15	0
20	" "	1	0	25	" "	7	4	15	" "	15	3
15	" "	1	3	30	" "	7	9	20	" "	15	6
10	" "	1	6	25	To One	8	0	25	" "	15	9
5	" "	1	7½	20	" "	8	3	30	" "	16	0
	Eleven o'Clock	1	9	15	" "	8	7	25	To Three	16	3
5	Past ditto	1	10	10	" "	9	0	20	" "	16	6
10	" "	2	0	5	" "	9	6	15	" "	16	9
15	" "	2	3		One o'Clock	10	0	10	" "	17	0
20	" "	2	6	5	Past ditto	10	6	5	" "	17	3
25	" "	2	9	10	" "	11	0		Three o'Clock	17	6
30	" "	3	0	15	" "	11	6	5	Past ditto	17	7½
25	To Twelve	3	4	20	" "	12	0	10	" "	17	9
20	" "	3	9	25	" "	12	4	15	" "	17	10½
15	" "	4	3	30	" "	12	9	20	" "	18	0
10	" "	4	9	25	To Two	13	1	25	" "	18	0
5	" "	5	2	20	" "	13	6	30	To Four	18	0
				15	" "	13	9	25	" "	18	0
	Twelve o'Clock	5	6	10	" "	14	0	20	" "	18	0
5	Past ditto	5	10	5	" "	14	3	15	" "	18	0
10	" "	6	3		Two o'Clock	14	6				

TABLE, No. II.

Showing the time the tide arrives at any of the marks made on the shore, &c., with the depth of water shown on the tide gauge at the same time, and this deducted from the full rise of tide, their difference will be the depth to be recorded on the map or plan.

Marks on Shore.	The Time the Tide arrives at each Mark.	Depth of Water on Tide Gauge.	Full rise of Tide.	Depth of Water to be recorded on Plans.
		Feet In.	Feet In.	Feet In.
A	The Tide Gauge half-past Ten			
a	25 Minutes to Twelve	3 4	18 0	14 8
b	15 " " "	4 3	"	13 9
c	15 " past "	6 7	"	11 5
d	15 " " "	6 7	"	11 5
e	15 " " "	6 7	"	11 5
f	25 " " "	7 4	"	10 8
g	25 " " "	7 4	"	10 8
h	30 " " "	7 9	"	10 3
i	15 " to One	8 7	"	9 5
j	10 " " "	9 0	"	9 0
k	10 " " "	9 0	"	9 0
l	10 " " "	9 0	"	9 0
m	10 " " "	9 0	"	9 0
n	5 " " "	9 6	"	8 6
o	5 " past "	10 6	"	7 6
p	5 " " "	10 6	"	7 6
q	10 " " "	11 0	"	7 0
r	10 " " "	11 0	"	7 0
s	25 " " "	12 4	"	5 8
t	25 " " "	12 4	"	5 8
u	15 " to Two	13 10	"	4 2
v	10 " past "	15 0	"	3 0
W	20 " " Three	18 0	"	

In explaining the use of this Table, suppose for instance that on the flow of the tide I observe the water had just arrived and settled at the mark *f* (at the base of the west pier-head), twenty-five minutes past twelve; and on comparing my observations with those of my assistant's, I find the depth of water shown upon the tide gauge at that time was 7 feet 4 inches; consequently the point of the pier head will be that much above the zero mark of tide gauge, and if that 7 feet 4 inches be deducted from the full rise of tide, the difference, 10 feet 8 inches, will be the depth of water at *f* on an 18-feet tide.

From the above data to form sections of any part of the harbour,in the first plan take the distances from the place, and the depths from the Table No. 2; draw the datum line, viz., high-water line, on which set off the horizontal distances of objects from one point to another; then again from these points let fall perpendiculars, on which set off the depth of water at the several places; then, by connecting these last-mentioned points together, you will have the form of the beach or shore.

OBLIQUE BRIDGE OVER THE RIVER GAUNLESS NEAR DARLINGTON.

TO THE EDITOR.

SIR,

I BEG to hand you the accompanying drawing of an oblique bridge erected over the river Gaunless, on a branch railway from the Stockton and Darlington Railway, called the Hagger Leazes Branch; together with this communication, which, if you think worthy of inserting in your Surveyor, Engineer, and Architect's Journal, you are at liberty to do so.

The bridge is built of stone, and at such a height as to suit the line of railway with which it is connected. The obliquity of the angle which the line of railway over the bridge forms with the river, induced me to transmit to you this drawing and communication, and shows to what extent of obliquity bridges of this description may be carried, when properly executed on the spiral principle; which a few years previous to the time of its execution was thought impracticable, and even at the present time deemed not advisable to build any at a more acute angle than forty-five degrees; this angle being thought the minimum at which a bridge, with safety and stability, can be carried into effect; but what little thought and design appear in those ideas when compared with the present structure, executed in the year 1830, at the very acute angle of twenty-seven degrees. The breadth of the roadway within the parapets, being only for a single line of rails, is 12 feet, the breadth of the river at the point of intersection being only 19 feet, while the span of the arch is 42 feet; and when the centring was struck, the arch did not drop more than half an inch at the crown, showing with what truth and exactness the work had been executed; and as a further proof of its stability, twelve years have elapsed since it was completed, and it is now standing as firm as the first day the coal trains passed along it.

It may be thought that the acute angle at which this bridge is built might have been avoided, and consequently that it was unnecessary to hazard such extremes, merely for the sake of having the name of so doing, at the expense and risk of the Company, or that the bridge might have been built of other materials, in using which, its construction could have been so altered as to avoid all unnecessary risk, and become an easy matter to accomplish; but such was neither the case nor intention, as the whole of the branch, which is five miles in length from the commencement to the terminus, follows nearly the course of the river Gaunless, crossing the same in its route four times, and hemmed in on both sides by high banks, whence any deviation from the line adopted and executed, would have been attended with very considerable expense, especially at the point where the bridge is built; and the necessity of crossing the river here is unavoidable on account of the very high land and well known common called Cockfield Fell, from its abounding in numerous minerals of the very best quality, bordering close upon the river on the one side; also a range of cliffs nearly 200 feet in height on the other; and considering the proximity of sandstone, the very best material for bridge building, it would have been unwise to employ any substitute, especially when this stone could be procured at so low a rate.

The bridge is built on the spiral principle, without reference to any work on oblique bridge building, or even to Mr. Peter Nicholson's work on stone cutting, nor am I aware that any work on the subject was in existence to assist the superintendent or builder at the time this bridge was executed; not that I wish to detract from Mr. Nicholson any part of that credit which is due to him for his invaluable work on the oblique arch; and I have no hesitation in stating that his treatise is sufficiently near the truth, and clear enough, even to the meanest capacity, to enable a good workman to execute the oblique arch of stone, with the greatest nicety and exactness; as witness the three-arched bridge of sixty feet span each arch, over the river Tees, in the line of the Great North of England Railway, and at an angle of fifty degrees with the river, erected by James Hogg, entirely on Mr. Nicholson's principle: a better arch cannot be turned, and which he ought to have had the credit of designing, being both consulted and paid by Mr. Henry Welsh (surveyor for the County bridges, Northumberland, and architect for the bridge), previous to submitting his plans to the Great North of England Railway Company, by whom they were subsequently adopted.

The utility of oblique bridges, especially on railways, is already sufficiently known to need no comment of mine to point out the advantages resulting therefrom; especially where stone can be procured at a moderate price, which material is allowed by all to be the best adapted to bridge building in any situation where strength is required; next to it is brick or cast iron, the last of which has as yet been so constructed as to be more costly in most cases than either of the former, and which has prevented its more general use in many instances where it might have been employed with great advantage, both as to cheapness and stability; consequently it is my intention at no very distant period to lay before the Institution of Civil Engineers my plans and ideas of a much cheaper and better mode of using it than has hitherto been practised in bridge-building on railways of those materials, and at the same time be equally as strong as those now in use.

This branch railway, although perhaps unknown to you, is well known in this neighbourhood; therefore a short description of it may not be out of place, or uninteresting to those unacquainted with its mineral productions; but I will be as brief as possible in my observations respecting it.

Along the whole of the branch, in its immediate vicinity, the mines are valuable in the extreme, and also a considerable tract of country on each side of it, abounding as I have previously stated in minerals of the first quality, and teeming in abundance with nature's gifts, forming a valuable object not to be overlooked by the spirited and enterprising shareholders of the Stockton and Darlington Railway Company, although the ruggedness of the country through which the branch had to pass, formed an object of great difficulty, and was by many thought impracticable, considering the time at which it was executed; the Stockton and Darlington railway, with its branches, being the first public railway that was projected and carried into execution in England, and what, I believe, is not less singular than true, the best paying one even at this period; yet such was the nature of some of the most difficult excavations through stone, that the produce from such well repaid the proprietors, and in some instances part of the railway cost them nothing, when the surplus material of stone was taken into account for building purposes and railway blocks.

Some of the best Wallsend coals are carried from this very district to the London market, obtaining as high a price in most instances as the best Wear coal, and completely outstripping the very best of the "Coaly Tyne."

The branch railway terminates near to a place called Hagger

Leazes lane, and from this it derives its name; and close adjoining to it the lead smelt mills, belonging to the Duke of Cleveland, are situated; the distance of transit from the extremity to the shipping port on the river Lees, at Stockton, is twenty-six miles, and thirty to Middlesbro', on the same river.

The coal seams lie at a very easy distance from the surface of the ground, from about twenty to sixty fathoms; consequently the amount expended in winning the coals is light, when compared with those on the Tyne and Wear, and compensates for the distance they are to be conveyed by railway, and tonnage charged thereon as railway dues to the Company. The sand-stone, also, is of the most durable quality; it lies close to the surface, and blocks of almost any size can be procured from the quarries. The hardness and durability of the stone have been well tested as railway blocks, and in several other instances; and excel the whole of the numerous quarries in the neighbourhood.

The lead is also of the best quality, and the limestone answers well for building purposes. The whinstone or basaltic rock which runs across the Fell from south-east to north-west, is commonly known amongst the miners by the name of the "Great Trap Dyke," and lies also within a few yards of the surface, affording an abundant supply of roadway covering to the surrounding neighbourhood; but to what depth it penetrates the earth I am unable to inform you. It is an obstacle to the working of the coals in the mines, and traverses the country from the Fell in a south-easterly direction for about fifty miles, and crops out on the sea coast near Whitby; but is lost or rather unexplored as yet in the contrary direction. The various seams of minerals with which this district abounds are in abundance seldom equalled, and I should think never surpassed in any mining district whatsoever.

I am, Sir,

Yours most obediently,

JOHN STOREY, *Engineer.*

Darlington,
February 25, 1842.

[We shall be most happy to hear from Mr. Storey at all times when it suits his leisure and convenience; as we cannot receive too much information respecting the great coal fields of the north, and their accompanying minerals and fossils.—COND.]

PROCEEDINGS IN PARLIAMENT RELATING TO ENGINEERING.

THE principal public Acts at present before the House of Commons, connected with the engineering arts, are the following:

A Bill intituled an Act for regulating Buildings in large Towns.

A Bill to consolidate and amend the Laws relating to the Copyright of Designs for ornamenting articles of manufacture.

A Bill intituled an Act for the Improvement of certain Boroughs.

A Bill to amend an Act of the first and second years of his late majesty king William the Fourth, to empower landed proprietors in Ireland to sink, embank, and remove obstructions in rivers.

A Bill for the better Regulation of Railways.

The preceding Bills are brought forward by the Government, and if passed will constitute public Acts. Then, with reference to what is called the private business of the House, it is somewhat favourable to the prospects of engineering that the number of Acts solicited by companies and others, for the prosecution of public works, is unusually great, as will appear from the following list of these Bills, and of the objects sought in each, taken from the breviate, which, in every case, is prepared by the Parliamentary Agents for the information of the House.

SEVERN NAVIGATION. The object of this Bill is to make provision for improving the Navigation of the River Severn, from the *Lower Parting*, in the county of *Gloucester*, to Gladder, or *Whitehouse Brook*, in the county of *Worcester*.

GRANTON PIER. The object of this Bill is to give some further powers to the Duke of Buccleugh and Queensberry, with reference to the Pier and Works at Granton, in the County of Edinburgh, which he was authorized to construct under an Act of the 7th W. IV.

COTTENHAM, &c., DRAINAGE. The object of this Bill is to provide for draining certain Fen Lands and Low Grounds in the parishes of Cottenham, Rampton, and Willingham, in the county of Cambridge.

SOUTH EASTERN RAILWAY. The object of this Bill is to extend the term for completing the South Eastern Railway, and to enable the Company to raise some additional capital.

MIDLAND COUNTIES RAILWAY. The object of this Bill is to enable the Midland Counties Railway Company, incorporated by an Act of the 6th William IV., to raise additional money, and to give some further powers to the Company.

GREAT NORTH OF ENGLAND RAILWAY. The object of this Bill is to enable the Great North of England Railway Company to abandon a portion of their proposed line of railway, and to sell the lands which had been acquired by them for the purpose of constructing that portion.

BRANDLING JUNCTION RAILWAY. The object of this Bill is to enable the Brandling Junction Railway Company, incorporated by an Act of 6 & 7 William IV., to raise a further sum of money.

BOSTON HARBOUR, &c. The object of this Bill is to repeal an Act of the 5th William IV. which has proved inoperative, and to make better provision for effecting Improvements in the River Welland, and the Port and Harbour of Boston, in the county of Lincoln.

SAINT PANCRAS IMPROVEMENT. The object of this Bill is to remove doubts as to the validity of an election of Commissioners for Improvement of certain Streets in the parish of St. Pancras, which took place under an Act passed in the Session 4 & 5 Victoria.

SURREY NEW ROADS. The object of this Bill is to provide for improving certain Roads, called "The Surrey New Roads," in the several parishes of St. Mary, Lambeth; St. Mary, Newington; St. George, Southwark; St. Mary Magdalene, Bermondsey; and Christ Church, all in the county of Surrey.

EDINBURGH AND GLASGOW RAILWAY. The object of this Bill is to enable the Edinburgh and Glasgow Railway Company to raise some further capital, and to make some changes in their Management, and in the tolls taken by them, and to make an extension in the Tunnel to be constructed by them near Glasgow.

CHELTENHAM AND GREAT WESTERN UNION RAILWAY. The object of this Bill is to enable the Cheltenham and Great

Western Union Railway Company to raise some more capital, and to enter into arrangements with other Companies for selling or letting to them the whole, or a portion, of the Railway. The Bill also extends the term limited for acquiring lands and completing the works, and gives some further power with regard to the taking of lands.

NATIONAL FLOATING BREAKWATER COMPANY. The object of this Bill is to constitute a Joint Stock Company (not intended to be incorporated), for the purpose of purchasing certain Letters Patent for a certain method of lessening the mischief arising from the shock or force of the waves of the ocean, lakes, or rivers, and preventing the injury done to breakwaters, mole heads, piers, &c., and also of adding to the security and defence of harbours, roadsteads, &c. It is also intended to enable the Company to sue and be sued in the name of the Company or their Secretary.

GRAVESEND TOWN PIER. The object of this Bill is to give some further powers to the Municipal Corporation of Gravesend, for the improvement and regulation of the Gravesend Town Quay and Pier, and to enable them to borrow a further sum of money.

DUNDEE AND ARBROATH RAILWAY. The object of this Bill is to enable the Company to raise a further sum of money, and to amend some of the provisions of the former Act relating to that railway.

LONDON AND BLACKWALL RAILWAY. The object of this Bill is to enable the London and Blackwall Railway Company to borrow money, and to purchase some additional lands for improving the approaches to the Railway. A further object is to facilitate the collection of rates payable to the East and West India Dock Company, in respect of the Brunswick Wharf.

NORTHERN UNION (*Newcastle and Darlington*) RAILWAY. The object of this Bill is to incorporate a Joint Stock Company for making a Railway for completing the Railway communication between Newcastle-on-Tyne and Darlington, with a branch Railway to the city of Durham. The Bill also empowers the Company to lease their Railway to other Companies, and makes provision for regulating the traffic on a continuous line of Railway from Darlington to Newcastle-on-Tyne.

DEPTFORD PIER. The object of this Bill is to extend the time for the purchase of lands, and the completion of the works of the Deptford Pier and Improvement Company, and to give them some further powers.

WINDSOR BRIDGE. The object of this Bill is to extend the term of the Windsor Bridge Act.

SOUTHWARK IMPROVEMENT. The object of this Bill is to provide for making a new street from High Street, in the Parish of Saint Saviour, Southwark, commencing at Three Crown Square, into Blackfriars Road, nearly opposite Stamford Street.

METROPOLIS IMPROVEMENTS.

THE Committee of the House of Commons, which sat on this subject in the last Session, finding that the evidence they had received was insufficient to enable them to come to any satisfactory conclusion, and that the advanced state of the session did not enable them to obtain such additional evidence, presented the following report to the House of Commons:

"Your Committee, considering the late period at which they commenced their inquiries, and consequently that the evidence which they have been able to obtain is incomplete, consider that they best discharge the duty confided to them by abstaining from submitting such evidence to the House, or any opinion on the subject-matter referred to them; but they cannot separate without representing to the House their opinion, that the inquiry ought early to be revived in the next session of parliament." In pursuance of this representation, Sir Matthew Wood has already moved for the re-appointment of a committee on the subject, but, in consequence of some intimation which the Honourable Baronet received from the ministerial benches, his motion was withdrawn. We have since heard, but we cannot vouch for the accuracy of the statement, that a commission is to be appointed by Government, with power to select such improvements as they may deem most proper for immediate execution. We trust that no unnecessary delay will take place in the promotion of so important an object, particularly as the Chancellor of the Exchequer expressed to the committee of last session his readiness to advance the sum of £533,000 for metropolis improvements, and requested to be furnished with specific information as to the times and sums when this aggregate amount would be required.

H.

ROT IN TIMBER.—MR. KYAN'S PROCESS.

"The one sore breeds the worm, but more
Of worms will breed another sore."

ON the evening of Tuesday the 15th of March, there was a regular "set-to" between two sections of the Institution of Civil Engineers, on the subject of kyanised timber, that is, timber impregnated with corrosive sublimate or chloride of mercury,—the one party standing sturdily up in favour of kyanising, (chloro-mercurializing is the proper term), as being as curative of diseases in wood as the man contended that cutting the throat was of maladies in a calf—that is, it healed all ailments; and the other party repudiating the same, and maintaining by equal force of syllogism and trope, that, whatever the kyanising may do in case of symptoms, it can have no tendency to heal, far less to prevent, diseases, which last is the grand point at issue. We readily and cheefully admit the talent and ability of those engineers, and the skill with which they give effect to these in all their works properly so called. Such bridges, such canals, such railways, and such engineering works of every kind, are designed and executed by them, that the world never witnessed their equals; and, in an age more just and less critical than the present one, all of them would have been regarded as *dignus vitulæ*, and in days gone by they would have "grown up like calves in the stall," with most appropriate and well-earned and becoming honours. In alluding to the calf, we do it in truly classical style, after the manner of the Romans, who regarded that animal as an especial symbol of merit in like manner as the ox-skull was a symbol of architectural taste.

What we mean to state by these preliminary remarks is, that, as engineering justly stands at the head of the useful sciences in a national point of view, so British engineers, and their association as forming the engineering constellation, stand higher than any other engineers in the world. This is undeniable; and the fact is,

that in the most improving countries and districts of the continent, British engineers are, in spite of the tendency which nations have to prefer their own people, in greater request than any other engineers in the world, at least in the designing and superintending departments. While saying this, we do not wish even to insinuate that as men, and men of general science, there is any natural superiority in British men; because, in as far as the sciences are concerned, this is contradicted by the facts. But still there is something superior, otherwise foreigners would not make the selection for British engineers and against their own. In the kindred sciences of surveying and architecture we do not find this to be the case; for a foreign people rarely if ever send for and employ a British surveyor or architect: in so far as surveying is concerned, we may say with truth that we are inferior to the more advanced foreign nations; and we are so because government surveys are of later introduction among us, and even now they do not reach the points most necessary to be known. The foreign government surveys, especially such as those originated and in so far conducted by Bonaparte, all had national or rather government objects; but, with the exception of the ordnance survey, (and the exception there is a partial one, that survey not reaching the points most necessary to be known), there has been no general survey under the direction of the British government, excepting such as was supposed to bear upon the adjustment of the allowance for the poor or the commutation of tithes to the clergy. Even these were restricted to the mere ascertaining of the extent of surfaces, without allusion to the other subjects, which may be said to be most necessary in a useful survey. What some of these subjects are we endeavoured to state in our preceding number, in a letter addressed to Colonel Colby, (who, by a typographical error, is there called Colonel Coby, but the Colonel is so well known and so highly respected, that no one connected with the subject can be misled, neither can he be offended by a mere typographical error.) Not one of those measurements to which we have alluded is worthy of being considered or called a general survey, for none of them bears upon any general subject; they are only particular measures upon a larger scale than the usual mensurations of estates, but not different from these in kind. Of surveys deserving the name, as serving useful purposes, the best is that of which the idea is given by Mr. J. B. Denton, though at present we have it in idea only, and not practically worked out.

So much for British surveying; and, from this account of it, which is perfectly accurate, we need not wonder that British surveyors are not employed in foreign countries. As for architecture again, there is no modern system, and the ancient ones are matters of taste, not of judgment and experience; and hence we need not wonder that British architects are not employed in foreign countries. With engineering the case is different, and enables foreigners to employ British engineers with advantage. This does not arise from any superiority on the part of these engineers, because, in this respect, a Briton is in nowise superior to his neighbours. The cause of it is, greater experience on the part of the British, and this is merely an imitation; for experience in any one matter is the means of producing experience in other matters, how different soever these may be in kind; and it is because Britons have had experience in various other matters that they are esteemed as engineers, and employed by foreigners as such; nor can we help, though we were so inclined, to admit this superior experience on the part of the British engineers, or can we fail in acknowledging its advantages to their full effect, and saying, that our engineers are unquestionably the very best in the world. We have no doubt that we are right in saying that it is this eminence in their own profession, and consequent attachment to it and engrossment by it, which characterise our engineers, and which appear to occupy them the more completely the higher they are in the profession. In some respects this is an advantage, because it prevents them from devoting themselves to those trifling matters by which so many professiona. men, in other departments, are seduced from their professions, and thus they never attain even a moderate degree of eminence in them.

This, however, is one of those goods which, in the majority of cases, is counterbalanced by evils, and evils of the most serious character. For there are a number of subjects which are not, strictly speaking, branches of the engineering profession, and which yet are indispensable to a properly qualified engineer. One of these is, mineralogy, or the knowledge of mineral substances, their individual characters and properties; and the other is geology, or the consideration of minerals in their aggregate character, and the nature of the strata which they form in their aggregation. The first of these is the one which more particularly belongs to architecture, though in so far as engineering is architectural, it belongs to that also, but with several important additions, wherewith the architect has very little to do. Besides these, both mineralogy and geology, but more especially the latter, naturally bear upon surveying; and their bearing upon it is different from that of the other two. There are two departments of surveying in which the sciences of minerals are especially useful; but the data for ascertaining them are very defective, and, of course, so are the conclusions founded upon those data. The defects of those data were, to a certain extent, pointed out in a preceding number, where also the ordnance map was recommended as the vehicle for supplying the larger deficiencies; and of course the foundation upon which to work out the smaller ones. The connexion between the sciences of minerals of the one hand, and architecture and engineering on the other, is, however, of too much importance for being treated in conjunction with, or subservience to, any other department which is auxiliary to the sciences under consideration. It is worthy of being treated as a separate article, and we shall afterwards treat it as such; and, in the mean time, proceed to that department more immediately expressed in the title to this paper, namely, the preservation of timber by saturation with different substances, and more immediately with chloride of mercury, which is the chief ingredient in the operation erroneously termed kyanising. The process has been some considerable time before the public, and under a direct trial; and yet, strange to say, engineers are divided as to whether it produces any effect or not; and they are still more divided as to its specific effect, if it does have any effect at all. The chief reason of this appears to be the fact that the cause of its action is not known, and this evinces, on the part of engineers and architects, including shipwrights, a very gross ignorance of the physiology of timber, a subject to which they ought to pay the greatest attention, because here, not only vast property, but a considerable number of lives, are dependent upon their knowledge—knowledge which they do not possess. The first question on which they ought to inform themselves is, whether kyanising acts simply as a medicine acts upon the animal subject, or whether it exerts a protecting influence, which changes the nature of the timber, and thus prevents it from being attacked by disease. This is the important question; for upon it all the others depend. If the solution

of chloride of mercury is merely a medicine, then the timber must be in so far rotted before its effects become visible; and as there is no panacea in medicine, the timber is still liable to the rot. If, on the other hand, this saturation actually changes bad timber into good, it deserves all the encomiums which its abettors lavish upon it. If, however, this is the case, we would take the liberty of asking whether it would not be a little more philosophic to attempt this change on the timber when it is still in growth; because, whatever may be said about kyanising or otherwise preserving dead timber, by changing it from bad to good, always struck us as being of the same class of operations with curing a dead sheep of the rot, or a dead horse of the glanders.

That chloride of mercury and a number of other substances will kill *Merulius lachrymans*, and the other fungi that grow upon wood, when that wood is in an incipient state of decomposition, we do not deny, because, to say that anything which kills a fungus will kill a fungus, is as sheer a truism as folly, under the guise of wisdom, ever uttered. But all decays of timber are not owing to fungi, or, to speak more correctly, fungi do not appear upon all decaying timber, but are present or absent, and when present vary in their species, with differences of the kind of timber, and also with the state of it as to proneness to decay, or the reverse; and we not only think, but are thoroughly convinced, that this is the real point at issue, nor can we see how it can be cured by kyanising, any more than we could kyanise bad and perishable oak into sound and durable timber, or kyanise beech into oak, or any one kind of timber into any other, or kyanise a blockhead into a man of sense.

The most simple and general state of the question is, Upon what does the kyanising, or any other preserving liquor act? Is it on the ligneous texture, or on the juices which the cells of that texture contain. If the latter, then thorough drying of the timber, so as to remove all the natural sap, would take away the whole cause of the disease, whether fungi were symptomatic of it or no, and, consequently, it would thereby completely remove the disease itself. That the juices of some plants are more conservative than those of others, must be admitted; and it must also be admitted, that they are different in different kinds of timber, and also in the same kind when placed under different circumstances. Some, for instance, are conserved by a resinous juice, at the head of which class, the *Deodara* or cedar of India may be placed, especially as grown and as exposed in the state of timber in that country. But we know not how far the Deodara might be changed to a less durable timber if grown in such a country as Britain, or any other high latitude, or when exposed to that damp and closeness of air to which timber employed as the material of ships is always exposed. The other Coniferæ have different degrees of durability, but all apparently depending upon their resinous juice, though in some the resin is mixed with other substances, which modify its operation. Among the very durable ones of dry climates—dry as respects both the growing trees and the timber, the cypress stands conspicuous; and in its locality it is a mountain-tree, as well as the Deodara, though, perhaps, it does not grow at such elevations, and, as is the case with the other, we know not to what extent its qualities, including durability among the rest, might be changed by difference of climate during the period of its growth. We know the remarkable changes which a different exposure, though there is no difference of climate, produces on the timber of several trees; and this difference may in all probability be one of conspicuousness only, and not one of reality. The case of the Scots fir, *Pinus sylvestris*, is a very remarkable one; for, when those trees grow upon a knoll, those on the north side are always superior in their timber to those which grow on the south, and when the exposure to the sun is great, the north side of the tree is always the best timber, and the south side is the worst. The resin is a tell-tale in such cases; for, as it is the conserving substance, and coloured in the pine alluded to, the red wood is, generally speaking, the most durable: we say "generally speaking," because, in our observations on the growth and timber of Scots firs, for which we had the very best opportunities, we have seen, in the centre of the trunk, a cylinder of red coloured wood in which decay had begun, but whenever the annual growths were of considerable thickness, those on the south exceeded in quantity, and those on the north in hardness and durability. On the other hand, wherever we have found wood hardened by being in the shade of a hill, or the north side hardened by being the shady side of the tree itself, we have found the annual cylinders of growth much thinner, as well as the colour darker; and in those cases where there was a central cylinder dark, and beginning to decay, we have found the timber in bleak situations, and on cold and barren soils. But, if this is found to be true in the case of one species of tree, it must also be the case in other species, and perhaps in the greater number, or even the whole. Thus, as there is an established connection between the soil of certain species of trees, and the timber which those trees produce, there is no reason why a similar connection should not exist in other species, though it may be less apparent to our observation. In the case of the Scots fir, we have a remarkable instance of the preservation of the central part of that tree, when immersed in water: what we allude to is the bog pine, which is so very abundant, and so durable in quality in Ireland, even in situations where the little pine timber which is now grown is not very durable. Whether the pine timber grown in that country some time ago, was as durable as that of the old forests of Scotland, we have no means of ascertaining, because the Irish forests were most absurdly and unjustly destroyed by the English, who, as is but too commonly the case with conquerors, began their possession of that unfortunate country by endeavouring to render it not worth the possessing. From the inferiority of the more modern pine timber of Ireland, no conclusion unfavourable to that country can be drawn, as there is, in the modern pine timber of Scotland, a similar falling off in quality, as compared with that of more ancient growth. The study of the pine timber of the British islands, together with the connection of its changes with the changes of the country, is rather a lengthened history; and the few hints which we have given respecting it must suffice for all that we have to say on the preservation of timber trees, as resulting from the changes of their quality.

The chief of the other substances which affect the growth of timber, are impregnation with astringents, with gums, and with aqueous substances. Besides these, there are many others, but they are of such a nature that they cannot be brought into anything of the resinous kind. They are for the most part aqueous, saccharine, or some substance not difficult of solution in water.

Of astringent timber trees, the oak is the most conspicuous; and, because it is the ship timber by way of excellence, it is that whose diseases, in this maritime country, attract the greatest attention, and therefore it and they are most worthy of the attention and study of engineers and architects, though we believe the gentlemen of both professions have their attention so much concen-

trated upon the constructive parts of those professions, that they give themselves small concern about the quality of timber, and are in a great measure ignorant of it. The ancient oak, which is found exposed to the air in old buildings, exhibits very few symptoms of decay, and none of what is called dry-rot, or any rot whatsoever, farther than a surface decay from the action of the weather, which is exceedingly slow in its progress, and does not come under that denomination.

The rot of oak timber, whether of that used for the construction of vessels, or for any other purpose, is an affair of modern times, and was not known, especially in ships, until after the old self-planted oak of England had become scarce, and softer and less durable timber from the north of Europe, and some from America, was used as a substitute. Every one will admit the absurdity of supposing that the introduction of this inferior foreign oak can have been in any way the cause of rotting or otherwise deteriorating the quality of English oak; and yet it is remarkable that disease in our own oaks was not mentioned as very frequent or very serious, until about the time when foreign timber was introduced. Soon after this, however, it appeared in oak timber, to whatever purpose that timber was applied. In houses, when perfectly dry, the timber crumbled into dust, and when they were exposed to the damp at the weather line, dry-rot, with its fungi, though not the Merulius, which is so destructive to shipping, made their appearance, and the same thing happened in posts. Even when undecayed in the part above ground, and nearly so in the part below, they decayed at the water-line, and the moment that the decay had made some progress, the fungi came on to complete what had been begun by other causes.

Other woods besides oaks are subject to rots or decays of some description or other, and in most of them these diseases come on earlier than they do in the oak, and the progress of some of them is marked by fungi, while that of others is not. Some, also, decay most readily in the dry state, and some in the moist, circumstances which pre-eminently claim the notice of the civil engineer, as calculated to guide him to the kind of timber which he should choose for aerial purposes, and which for aquatic ones, because there is scarcely one species of timber which is equally durable in both.

Resinous and astringent timbers are, for the most part, the growth of cold or temperate latitudes, or of grounds so highly situated that they come under these descriptions. Gummy trees, on the other hand, are more characteristic of warm countries, and also of the warmer part of temperate ones, though they are most abundant in the former. As gum is soluble in water, this substance, whether very apparent in the tree or not, and whatever be its durability when kept constantly dry, is always subject to decay from damp, whether of the waters of the atmosphere or not; and it is especially so subject at the water line. Of this, we have an example in the mahogany, *Swetenia mahogoni*, which is durable in dry air, but loses its colour, and becomes soft, when exposed to damp. Of durable trees, which have no very decided character in their juices, the common teak, *Tectona grandis*, is one of the most remarkable. Indeed, it is the most remarkable of this description, and perhaps of all trees, as a durable timber. In strength, it is equal, and perhaps superior, to the very best oak; and as a ship builder's tree, it appears to be superior to all others, being proof to every climate, and standing both water and humidity, without rot, or any other disease: it thus requires no kyanizing or other process to make it last.

The peculiar qualities of the juices of timber are thus so numerous, and liable to be affected by so many and such different agents of decay, that it is hardly possible to suppose any single subject, whatever may be its nature and composition, to have a conservative effect upon the whole of them. Far less is it probable, that the compound proposed by Mr. Kyan is the best subject for this purpose, or even a substance fitted for it at all. It may, however, be such a substance; for, in cases of perfect ignorance, there is nothing which we may not both affirm and deny, just as we please; and certainly a solution of corrosive sublimate, as the cure for all vegetable disease, comes under this most convenient denomination. It is true to the abettors of the hypothesis, and false to those who are not its abettors; and when we have said this, we have rounded the whole tale of its hypothesis. Instead of knowing that any one compound is a cure for diseases, or for any one disease, in the juice of plants, we are perfectly ignorant as to whether the juice is or is not the seat of any disease; that it may be such is probable, but not more probable than that it may not be such; and hence this part of the subject comes within the category of indeterminables, with which no man knows how to deal. The life of plants is a matter of the greatest obscurity, as well as that of animals; for, as it is well expressed of the latter, we lose it when we seek to find it. But it is much more likely that, if the life of plants is in either of these substances, and not in the plant itself, considered as a whole, it is in the ligneous texture. Ligneous texture is an inert substance, a substance which one may call in a state of absolute death, and, therefore, one can with difficulty imagine the possibility of its being diseased, or admitting of cure. But though ligneous fibre is not a living substance, any more than the other, still it is one of which life can be more easily predicated. And, therefore, though we know nothing about either of them with anything like certainty, the hypothesis of disease and cure, in the ligneous fibre, is at first sight the more likely of the two, but it is this only at first sight; for when we reason upon the philosophy of the matter, we can come to no more certain conclusion here, than in the other case, if, indeed, our conclusion, if conclusion it can be called, is not less certain. Vegetable tissue is a fibrous or cellular texture; and in so far as this goes, it agrees with the substance of animals, which, in the living state, is also fibrous or cellular. But here that parallel ends; for the ligneous tissue bears no farther resemblance to animal matter than has been now stated. On the contrary, when it contains no juices, we might as soon predicate animal life, or disease, or cure of a dead animal, as of this sapless vegetable substance: therefore, when we examine the leading parts of which timber is composed, we cannot say that disease is inherent in, or can be cured by, any application to either of the two; and so thus far the scheme of Mr. Kyan is without any basis.

But if we are thus compelled by the philosophy of the case to discard it both from the juices and from the ligneous texture, the question is, where is it to be found? and to what does Mr. Kyan apply this panacea of chloric acid? Besides the two which have been named, there is no substance upon which this or any other agent can have an effect either in the way of disease or that of cure; and thus Mr. Kyan cannot apply this liquor to anything substantial. Besides the substantive parts of timber, there only remains the union of the two substances, that is, the relation between them, and surely that is not an object upon which anything can act. Action upon one or other or more of the parts may have an influence upon the union of those parts; but no action upon the union can have any effect upon the parts themselves. We

grant that such a union is life, and that both disease and cure act upon the life, but they do so only through the medium whose union forms this life. Therefore, when we predicate disease or cure of what we call the life of a vegetable, we are just as much in the dark as when we predicate the same things, or either of them, of the juices, or either of them, or of the ligneous tissue. It follows, that when we inquire after that of which Mr. Kyan seeks the disease or the cure, the inquiry is respecting that of which nothing is known, and, therefore, we are just as well informed on any one branch of the subject as we are on any other branch, that is, we know nothing at all about them; notwithstanding this, what we have now stated is the only thing which brings before us the system of Mr. Kyan—the sole foundation of all that he sets before us—and if it has no meaning, the same must be the case with his process itself.

This is the gist of what is stated by Mr. Kyan; and it is passing strange that a doctrine like this should be in the nineteenth century set forth by any man calling himself a philosopher. Such, however, is the case, and Mr. Kyan is followed and believed in, not only by those who call themselves philosophers, but by others who bestow the same appellation upon them. This is the strange part of the matter, and one in which no man who is really a philosopher can agree with the abettor of the hypothesis. We grant that some men are ready to abet anything, be it what it may; but such men have no title to be considered as members of the Institution of Civil Engineers. Those engineers should be men of talent, and of purity in their talents and functions; and unless they are so they have no title to the reality, whatever they may have to the name.

Far be it from us to say this in earnest of so august a body as the Civil Engineers, because we think it would be unworthy of it; they are men of very high gifts and adornments, and, therefore, whenever we speak of them it should be in language becoming their greatness. When, however, we find them falling into such blunders as these which we have mentioned, what shall we think of their talents, and in what terms shall we estimate them? "If this is done in the green tree, what shall be done in the dry?" If men of prime acquirements shall commit those things, what shall we say of those men who have no acquirement at all? If these are in reality bad, those must be execrable beyond all measure. This is a truth which can neither be gainsaid nor repudiated; and they who would do the one or the other are not aware of what they say. They belong to the persons of no understanding, and with such they must take their lot. If this were true, it would be bringing matters to a sorry pass, and one which no man in possession of his senses would fail to lament. Such, however, is fortunately not the case; the engineers stand as pure as any class of men can well be imagined; and this supposed error is only a frailty, not a crime. At all events it is a something which we may mourn over as producing darkness where there should be light, and the gloom of a vision where all ought to be transparency and beauty. But there is no necessity for our mourning over this, because the beauty is quite real; and the darkness which we would mourn is in reality radiance itself.

The radiance which we would mourn is in truth a burning and shining light, in which any may exult as being delightful in the highest degree; and were there nothing but this to exalt human nature, it would still stand abundantly high; higher indeed than we can well imagine. It is not the gloomy side of human nature which is brought before us, it is the side which is the most radiant; and it is because of the brightness of human nature to us that we are thus induced to look upon it as something to be lamented. Viewed in a proper light, it is a very delightful subject, and one upon which the mind might dwell for ages, and feel happier every day. It is this gleam of glory drawn around human nature which constitutes its essence; and it is just because it seems thus small that it is truly great. Thus the grandeur of human nature consists in what appears to us to be the gloom, and it is lovely because it is dark and dreary. The gloominess of human nature is, therefore, the part of it upon which we should dwell with the greatest pleasure; and we should love it because it is dark and sad. This results from the apparent weakness, but real strength, of the subject; from that strength which appears to constitute its weakness. Being lovers of man, we naturally admire this apparent weakness, and admire its weakness, because in that weakness there is strength. It is here that we find real power, a vigorous grandeur, which has no parallel in any other part of the world, but which stands alone and without anything to equal it. It is in this that the subject of which we treat rises in grandeur above all other subjects. There is an apparent weakness which is real strength, an uplifting of man in that which appears to trample him down. Such majestic grandeur can appear in human nature, but in nothing else, and it can be displayed by no creature save man.

This is the glory of our race,—that which sets us high above all the other creatures that God has made; and this glory is our chief boast, our highest attribute, and our most exalted praise. As no creature but man can possess this high qualification, so no man can possess it except an engineer, who might truly be styled "the noblest work of God," without equal, and with no superior. But if such is the high attribute of man as such, the proudest exaltation of it consists in the dignity which is in the power of man to display. We do not maintain that he is exalted above all other creatures, and far less do we maintain that man, as an engineer, is exalted above all other men; but there is no denying that in this respect he ranks very high; and we strongly suspect that it is in this pride that he rises above all his fellow creatures. If man, as such, is a transcendent being, he is doubly transcendent in capacity, and may well be proud of his calling. We say without contradiction, or rather daring it, that, considered in this point of view, man absolutely overtops himself; and, great as he is in every respect, this makes him greater in them all. Much of this greatness depends on the fact of his being an engineer, and not a man of any other class. We are not certain, however, that this is not at once the glory and the shame of our kind, nor are we certain that herein lies not the chief humiliation of man. Man is an engineer, and being such there is that about him which sinks him far lower than he otherwise would be. We speak it to the shame of our race, but nevertheless it is true, that this apparent greatness brings much weakness and imperfection along with it. To possess eminent men of the engineering and collateral professions is one of the chief glories of mankind; but it is at the same time a glory not unmixed with shame, and involves us in many weaknesses from which we should otherwise be exempted. Thus, in this same matter of engineering, in company with much to exalt, we have perhaps more to humble us, and in nothing more than in the very subject under consideration; it degrades us in many respects, and in none of them more than in that of rendering us great amid meanness, and strong in our own estimation, while in reality we are weak.

The cause of this is, that a taboo has been laid by the members of the profession against all other professional men, and we could mention some striking instances in which engineers have exerted all their energies to prevent the execution of works of the greatest utility, simply because the inventors of these works happened not to be professional engineers. The best interests of the country call for the immediate removal of this taboo, a restriction of the most valuable of all the arts which ought never to have existed, and professional men ought to be contented with their superiority, and the reward which that superiority gives them, and have left the rest of the world to act without them, if it could. One very important ground of argument in favour of this perfect freedom on engineering subjects might be found in the profession itself. The most useful engineering inventions or discoveries, or whatever else they may be called, have not been made by professional engineers, but by men who, as it were, broke away from the humbler professions and trades, or those which engineers consider as such, and proved themselves to be engineers of nature's own making. Then, as to the engineers themselves, the very foremost men of the profession have not been bred engineers, but have come from something else by the strength of their own minds. The late Messrs. Rennie and Telford are instances of this, more especially of the latter branch of it, for Rennie flung down the saw and the plane, and Telford the chisel and the mallet, and the mill-wright and stone-mason became the foremost engineers of the day, engineers who have no equals even now, when the occupation is regularly taught, and even very young members, who have had little practical experience, advertise for pupils, and in that way earn the chief part of their living. "They manage matters differently in France," as Sterne says, with regard to subjects of a very different kind; for there the principle of engineering, or, at least, principles easily turnable to engineering, formed part of their general scientific education many years before there was a single pupil in Britain. We are not sure whether, so far as the local specialities of works went, there was not an advantage in this fact of the work, as it were, making its own engineer; and we question whether pupilage would have been of much advantage to Brindley in road-engineering, to Winstanley and the other contractors of unfortunate light-houses on the Eddystone, to Smeaton in his matchless structure upon the same rock, which has become the model of superior light-houses, or to many others that might be named. But, great as were these men on their own ground, they must often have been much at a loss for those principles of general science which are essential to readiness and skill, just as the engineers of the present day are at a loss for knowledge of geology, and of various natural sciences, of one of which the subject under consideration is a branch. These are matters, however, to be considered separately in all the pros and cons of their useful or necessary connection with engineering, and, therefore, we defer them to a future occasion, and address ourselves more immediately to the subject of the rot in timber, and the duties of engineers with reference thereto.

Durability in timber is desirable in every country where timber is used, and more especially with regard to subjects intended for public or general purposes, and erected at much labour and expense. But in a country like Britain, many of whose inhabitants, and much of whose valuable trade, is on the waters, the preservation of timber is, to say nothing of landward structures, a matter of most pre-eminent importance; and the number of men and vessels, and the quantity and value of merchandise which we see every day in peril in consequence of rot in ships, are far greater than any one not acquainted with the subject would suppose. Of all our annoyances, perhaps, this is the greatest. It is a private loss, affecting ship-owners in every part of the kingdom; and it is a national loss as affecting the Royal Navy: the destruction as respects that is so great, and its progress in some instances so rapid, that one would imagine that the demolition from these causes increases with the tonnage and value of the vessels; for there are instances of first-rate ships of the line being completely destroyed by rot, before they were finished; and thus one edition of the vessel was put on the stocks, and another launched into the waters.

When the timbers of a ship are completely rotted, the repair of the hull costs little less than the building of a new one, and thus the rotting of a single ship may cost a good many thousand pounds, independent of delay, which is a very serious matter in war time; therefore this is a subject which long ere now ought to have been thoroughly investigated and understood; and if there were no competent parties within the country, there has been time enough to give them the proper kind and degree of teaching, though this has not been done. Independently of furniture, and other domestic applications, there are many uses for timber, without reference to the particular structures, or parts of structures, for which the said timber is used. Its situation may be wholly under water; partly in the water and partly in the air; or it may be wholly in the latter; and to each of these, and many varieties of each, a different kind of timber is wanted, that which is fit for being under water not being equally fit for the air, and so on for a number of cases. The difference, also, sometimes lies in the species of timber, and at other times in the state in which it has been grown, because the latter influences the qualities of the timber, more especially its duration, hardness, and strength.

The growers of timber have, generally speaking, little knowledge of its qualities, even in the same species of tree; and they have but small inducement to study those qualities, for they are sellers, as well as growers of timber, and timber is sold by the solid foot, without any specific reference to its quality. In a few cases, it may be known that one situation and soil produce good timber, and another bad timber, of the very same species of trees; but, scanty as this knowledge is, it is by no means general, neither have the specific characters that occasion the difference been inquired into: something of the same kind occurs with regard to the timbers which are best suited for different situations, though the ignorance here does not appear to be so great as in the other case. The purposes to which different species of timber, that is, the timber of different species of trees, are best adapted, is a matter much better understood than the other, because differences of species are matters to be seen and judged of by experience, and matters of different quality in the same species have not been examined in their causes, and the very sources of the differences themselves are obscure, and do not come within the limits of ordinary observation; but still those differences in trees of the same species, are the important parts of the subject, and it is to them that we have mainly to look for the cause of every disease to which timber is liable, whatever may be the purpose to which it is applied in the arts; and, in our opinion, this is the quarter in which we are to seek for the causes of all rots, in whatever species of timber they may display themselves, and to whatever part of a structure the diseased timber, or timber prone to disease, may be applied. Upon this subject we have our own theory, and our own reasons for be-

lieving in that theory; but we shall withhold both until we have had some colloquy respecting the subject about engineers, and gentleman of the engineering professions, and their notions and proceedings upon these subjects.

The reasons why engineers do not study this particular branch, namely, the qualities of timbers, and the circumstances which produce good or bad timber in the same species, do not differ greatly from the reasons for similar ignorance on the part of the growers of timber; only the grower of timber, if the fault lies in the growth, has immediately in his hands the means of preventing the bad, whereas the engineer has those means only at second-hand, and in directions given to others. If, however, the members of the engineering professions were to make themselves properly acquainted with the characters of timber, especially with its durability when the trees are felled, but not worked, or even before they are felled, and refuse to purchase any timber save what was sound and durable, they would soon bring the grower to a state of better knowledge and more attention. The grand mischief, however, to which engineers and the engineering profession are exposed, and from which it appears that all the high talent, and the skilful workings in other matters, for which we so gladly and so justly, we believe, give them credit, cannot enable them to escape, is the fact that they are not, in one sense of the term, engineers at all, but engineering tradesmen seeking in the way of their trades, and doing nothing more. It is for the practice, the honest and successful practice of their trades that we give them credit; and if this extent of credit should happen not to satisfy them, we can say only that we do not give them more and higher, simply because they are known to us simply in the character which we have mentioned, and if they would but rise, our admiration would do the same, so as always to be ahead of them. They may plead that they have no status in society other than that which we have mentioned; and we admit the justice of their plea, adding only "So much the worse." In this they act upon the very same principle as all other tradesmen in Britain: they choose their trade or profession, do what they can to turn it to the greatest pecuniary profit, and here the matter ends. If an engineer be what is not unappropriately called lucky, and secure to himself the employment of Government, or of some influential man or men, jobs flow in upon him from all sides, and, by sheer luck, he becomes an oracle to be consulted, and waxes as rich as Crœsus. But, on the other hand, if the benignant planet of luck is not ascendant in his horoscope, he toils and moils as he best may; and because want of luck has prevented him from being a successful engineer himself, he takes to schooling others in the craft, with or without the hope that his pupils may win those golden somethings, or rather that substantial pelf, in quest of which their master has not succeeded. Even out of this, however, an argument rises in favour of the superior talents of engineers above those of ordinary teachers: the professor of engineering misses merely the art of his profession, and retains a share at least of the substantial reward, whereas both the labour and the remuneration are very often lost to the teachers of other matters.

Thus, we trust we have shown that, as a tradesman, the engineer performs his duty faithfully to the letter, and as that duty is of a superior order to the duty of any other tradesman, so the engineer is a man of superior caste, and one to whom artificers of all denominations should look up.

But here we would ask, is there no other duty which an engineer is called upon to perform in virtue of his office, and which is superior both in an individual and a national point of view to anything which is, or which can be looked for, or demanded of, any tradesman? We answer, Yes. Civil Engineers in their individual capacity have a second and higher duty to perform, because in this capacity they control the expenditure of large sums of money, of which the owners have no knowledge. Then, especially if they are formed into an Institution, as is the case in this country, they have a duty to perform in their joint capacity, superior to any that can be expected from any other class of men, be their profession what it may. In common with all other learned men, they are indebted to their country for a liberal education, though that country may have given them nothing in the shape of money or of any gratuity; every man is indebted to his country for the full value of that education which he has received at its institutions, and even if he attends no public seminary, he is indebted to society for that school of practice, without which he could not become an engineer. We have said that our engineers are men of great talents, but this only increases their obligations to their country, by affording them the means of improving and increasing those high talents. Therefore, in every view which can be taken of the matter, it is apparent that an engineer has something to do, some obligation to discharge, of greater importance than the faithful execution of jobs, how well soever these may be planned, and how properly and profitably they may be executed for the benefit of the parties concerned; and if an engineer is negligent in this higher duty, he is culpable at the bar of that society to which he owes so much, and this especially if a member and an influential member of an Institution of Civil Engineers, though even the humblest engineer is bound to the country to the full extent of whatever he is able to do for it. Here it will naturally be asked, how and in what an engineer is to discharge his obligation, and the answer is a plain and simple one, namely, that he is to repay society in a portion of that knowledge which the said society has enabled him to acquire. This is the way in which other professional men discharge their obligations; and in proportion as the talents and duties of an engineer transcend others, he is to overtop these others in the discharge of the obligation.

We see with pleasure that this year they have resolved to do something at the meetings of the Institution, more than sitting in solemn conclave upon inventions of new shoeing horns and improved hinges for water-closets. But still the improvements bear upon additions to the museum and library, rather than on anything else, —as if the discharge of their public duty depended on these. Now, admitting that the museum articles are useful, which is a large admission, their use is to the members of the society only, not to the public, or even to engineers generally, and thus they are matters of *esprit de cœur* as much as the grateful hanging of admired or beneficent members upon the wall where M. I. C. E.'s "do most love to congregate." In this way they may go on until they accumulate a mass of somethings, as numerous as that at the Adelphi; but it will be, as Nimmo said of the gimcracks there, "all useless alike."

It is not thus that the societies or colleges of other professions discharge the public and paramount part of their duties; for whatever new may be invented, whatever also may be improved in the converting and healing arts, is by them committed to the stream of time, and is all available to professional men round the world's wide girdle, and not a little, of the preventive department especially, is of much use to the public generally, if they would read, think, and

do as there directed. There is a parallel between these colleges and the Institution of Civil Engineers, not a parallel in kind, but one in application. We do not mean that the Civil Engineers should make up boluses for the gripes, or set broken bones; though it would be very useful if they could do the latter; and as little do we mean that learned physicians should "cast the waters" of plastic clays and quagmires, or eminent surgeons reduce the luxations of canal cuttings. But still there is a similarity, and as the public are not goaded on by the same personal inducements in these arts as in the curative ones, there should be vested somewhere a power of making them set their wits to work upon whatever is necessary to be known with regard to the professions, and especially with regard to the materials of which they make use. Being perfectly aware that all "boards" are subject to "rot" of some kind or other, we are not for any greater multiplicity of them than may be absolutely requisite, and as the Board of Woods and Forests has now eaten up the Board of Works, we think that subjects of great public interest, and requiring engineering advice, should be officially sent from the Commissioners of Woods and Forests to the Institution of Civil Engineers, backed by parliamentary authority; and then matters would be at least in train for something public being usefully done, considering the high talents and great acquirements of the parties consulted.

It may be said, Who is to pay the engineers for these exercises of their high talents? But this may be met by another question—Who pays the physicians and surgeons for the important results of investigation, study, and experience which they are continually communicating to the public? It will be replied, that what they communicate are the results of what they have been previously paid for by the public. But the case of engineers is precisely the same; and if, notwithstanding all their talents, which we rate so high, those talents are not directed to the proper subjects, the parties possessing them are not duly qualified.

Many subjects upon which this general engineering information is wanted, and cannot be given either by individual engineers, or by the Institution in its aggregate capacity, might be mentioned; but in the meantime we restrict ourselves to the rot in timber. The engineers, as a body, ought to know every thing about all sorts of rots, their causes, and their cures, if they admit of any; and it is really shame that the highly talented engineers of a country more dependent upon timber than any other country in the world should meet to discuss Kyan's patent, pro and con, somewhat like a spouting club, when in reality they ought, from general and undoubted knowledge, be able at once to say whether any application whatever can be useful in the case of rotted timber, and why. The main question, taking the lead of all others, ought to be, whether any application to timber, after it is felled and dried, will increase its durability. And the trifling experiments which have been made go very little toward the solving of this question, because two trees of the same kind, growing in juxtaposition, may produce very different qualities of timber, and so may different parts of the very same identical tree. Kyanising, and all operations of the kind, are therefore intransitive. If kyanised wood lasts longer than wood not kyanised, the difference may be in the wood itself; and an argument for any one piece will not apply to any other pieces; and even in the case of that one piece itself, engineers are not prepared to show that the greater durability is more owing to the kyanising or to the natural quality of the timber.

The great inquiry is respecting the dry-rot in ships, that of which *Merulius lachrymans* is the cause, according to Kyan and his followers, but only a symptom in our view of the matter. Several years ago we had a conversation on the subject with Captain Beaufort, the hydrographer-royal, in consequence of the then recent publication of a little book of ours, entitled "A Guide to the Observations of Nature," and intended to explain a few important points in different branches of science, with that natural simplicity and boldness which might lead to a more general study of natural subjects. Nothing followed from that conversation, which was grounded on a few remarks in the little book alluded to; but we have since had occasion to follow out our observations, on oak timber especially, and, from the observations we have made, we are every day more convinced, that rot in timber, that is to say, the fungus called rot, which is destroyed by such deadly poisons as that used in Mr. Kyan's process, is a symptom, and not a cause,—that it comes originally not to rot sound timber, but is called into existence by timber already in a state of incipient rotting, though the progress has made so little way as to escape common observation. This is an exceedingly common process in the vegetable kingdom, more especially in countries where most of the trees are deciduous: the spores or germs of the fungi seem to be dispersed every where, even through the juices of living animals and living plants; and they are so minute, that they are dispersed through the air like smoke, or vapour; but, when the season of decay comes on, they muster in numbers which no arithmetic can count—and every fading leaf, and every vegetable which decays, gradually becomes spotted by them, which spots increase till the parenchyma is reduced to a substance soluble in water, and fit for composing part of the soil for new vegetables. As even the most stately and enduring trees are not immortal, but have a period of years, beyond which they perish, so there are fungi which come upon the timber of the tree, when they begin to decay, just as these annual ones do upon leaves and other deciduous parts.

Here, therefore, there is a general system running through the vegetable kingdom, at least in temperate and cold latitudes, where the action of humidity is in excess compared with that of the sun. Life is, though unseen by us, suspended, or terminated in part or the whole of the plant; and the fungus comes in to hasten the decay, and disorganise the decaying matter, and change it to earth, which, but for the fungus, would require a considerable time, and a large fraction of workable matter would be at all times remaining idle. Thus, by a very slight study of the subject, we find a general law, regulating the coming of those fungi into growth; this law has all the beauty, all the usefulness, and all the perfection which we find in every law of nature; and, therefore, it would be contrary to the whole system of nature's Governor to suppose the process reversed in any one case.

So far as our observation goes, bad timber is bad from the beginning, from the very springing of the plumule out of the germ or the acorn; and, though it is doubtful whether the acorns of bad oaks can make good timber, yet it is certain, that, by soil and treatment, the acorns of good ones may produce bad oaks. Carbon is the substance to which all plants owe their hardness and durability, and if they start into growth with an insufficiency of carbon, they make bad timber, and this bad timber, once begun, cannot be changed to good timber, in the same tree, by any known process, for the existence of such a process would involve a contradiction of the laws of nature. The necessary conclusion is, that the fungus does not originate the rot in trees, nor does Mr. Kyan's process, or

any other of the kind, prevent the first beginning of the rot and fungus; these arise from the quality of the timber itself; and, though it may be little modified by circumstances, yet, if we are to have good and durable ships, the quality of our timber, at starting, must be good, as no process to which it may be afterwards subjected can impart to it the quality which is so desirable.

The general conclusion is, that bad timber is always badly grown, and, consequently, if we wish to have sound and durable timber, we must render it so in the nursery, and not by any process which can be applied after the tree is dead.

JOHN SMEATON.

These two words compose the name of a man whose history every young engineer ought to read, and every more advanced one try to imitate. If the pupil is endued with the proper love of the calling which he has selected, or has been selected for him, the first of these is an easy, instructive, and delightful occupation. The incidents recorded of the life of Smeaton are few, and as the world goes, remarkable for their simplicity, but although they are "few and far between," they resemble glances through a telescope of high power and perfect achromatic effect. In each of these brief glances the student has a clearer view of the man than could be obtained by many days and much minuteness of detail. For the grown-up engineer to imitate Smeaton is a far more difficult matter. He was an engineer not taught by man or chosen member of societies. His instruction and studies were from his Maker, and his imitators must be the same.

There is a definition of Civil Engineers in the preface to Smeaton's Works, which, whether sound or no, is so admirably descriptive of the man, that we cannot resist quoting it:—"Civil Engineers are a respected set of men, whose profession owes its origin, not to power or influence, but to the best of all protection,—the management of a great and powerful nation,—a nation become so from the industry and steadiness of its manufacturing workmen, and their superior knowledge in practical chemistry, mechanics, natural philosophy, and other useful accomplishments." The Works of Smeaton were published by a number of eminent men, and therefore we know not by whom this short paragraph was written; but it is literally true. We owe our superiority in the engineering arts, not to our colleges, but to our workshops; and all who have been truly great as engineers, have evinced a love for mechanics in their early youth.

This was remarkably the case with Smeaton, and he was the father of the profession in Britain. Circumstances, no doubt, favoured him; for he came at that auspicious epoch which brought out the talents of Arkwright, Watt, and others of a new class of men, who brought philosophy out of the schools, stripped off her monastic dress, and made her the handmaid of society.

John Smeaton was born at Aresthorpe, in Yorkshire, on the 2nd of May, 1724, his father being an attorney there. Of his school education we know nothing, but it must have been scanty, as he continued through life to write partly in the Yorkshire dialect, though not so inveterately as Emerson. His branch was among workmen, and his occupation when but a child, was to imitate them. Some interesting anecdotes of his early construction of windmills, pumps, and other miniature machines are given. His father did not relish those pursuits, or rather, perhaps, being occupied with the routine of his office, did not pay much attention to them. But this appears to have engrossed the whole mind of the future engineer; he made for himself a set of tools, some of them very ingenious, such as a vice, turning lathe, and one for cutting screws, and he forged his iron and steel, melted his brass, and performed many works not very usual for mere boys.

When he was about 18, his future partner, Mr. Holmes, visited him for a month, and still farther confirmed his taste. The same year his father took him to London to attend the courts of law. After some little time he found he could not reconcile himself to the dull and formal employment; and a strong remonstrance to his father obtained that gentleman's permission to follow the bent of his own inclination.

From this time, his principal residence, during after-life, was in London, where he continued for the first eight years, getting acquainted with the men of congenial habit, and acquiring knowledge and dexterity.

Though most indefatigable in his studies, and beloved by all who knew him, he assumed no profession until 1750, when he became a mathematical instrument maker. The same year he made to the Royal Society his first communication, which was well received; and he was elected a member of that body in 1754. In the same year he visited Holland and the Netherlands, and his study of Hydraulic Engineering then appears to have turned his thoughts to Civil Engineering; but it was some time before he got employed. On his return from the Low Countries, it is believed that he renewed or began his experiments on the natural powers of wind and water in turning machinery; but he did not lay these before the Royal Society till 1759, when they were honoured by the gold medal.

But though Smeaton was not immediately employed as an engineer, there must have been a strong feeling of his superior capacity in that way; for when, in December 1755, the Eddystone light-house was burned down, and the proprietors requested Lord Macclesfield, President of the Royal Society, to recommend them a proper engineer for its re-construction, he at once mentioned Smeaton as the fittest party that could be appointed; and the light-house stands, and we hope will stand for many ages, a splendid memorial of Lord Macclesfield's discernment and judgment. After the successful construction of this great national work, Smeaton engaged more vigorously than ever in his experiments on mills, nor was he in any regular public employment till 1764, when he was appointed one of the receivers of the Derwentwater estate. This estate, forfeited in 1715, belongs to Greenwich Hospital; and as it contains some very valuable mines of coal and lead, the machinery required the assistance of such a man as Smeaton, who made very great improvements. From this period Smeaton was very much employed as an engineer; and in 1765 he wished to resign his receivership; but his friends got him to stay two years longer. He and Mr. Holmes, in 1771, became proprietors of the Deptford Waterworks; and there was no work of any magnitude of a maritime nature which did not now receive a portion of his attention. It would be tedious to attempt enumerating all his employments from this time downward to his death; but we must not omit to notice, that the Forth and Clyde Canal was one of his schemes, and so were a number of drainages, and other projects in Marine Engineering. These were all original and correct in their

plans, and neat and substantial in their execution, which led every one to suppose that Smeaton was the best authority in all such matters.

One remarkable instance of Smeaton's readiness and decision of character deserves to be mentioned. Two arches of London bridge had been thrown into one by the removal of a pier and its foundations; and this, as was apprehended, would cause the fall of the rest of the structure. The apprehension rose to a very considerable degree of panic, and Smeaton, the only man who could remove this and restore tranquillity to the public, was in Yorkshire. An express was despatched for him, on which he set off immediately, and was soon in London. Repairing to the spot, he recommended that the stones of the City Gates which had been sold should be repurchased, and thrown into the river in the dangerous part, to serve as a temporary support till some effectual measures could be taken. This was done without losing a moment, and the bridge was saved.

The Reports made and the papers left by Mr. Smeaton, show him to have been a man of general science, as well as original and comprehensive views. His mental exertions seem to have exhausted his bodily frame, for a contested project for a canal from Birmingham to Worcester evidently accelerated his demise, which took place in consequence of a stroke of palsy which he had while walking in his garden, on the 16th of September, 1792: he lingered till the 28th of October, the same year. He, however, lived to complete his great work on the Eddystone Lighthouse. The high Court of Parliament and the Courts of Law, in the first of which he was frequently present, heard him with the utmost attention, and seldom deviated from what he recommended.

Mr. Smeaton was the first who established a society of civil engineers. The meetings were held at the Queen's Head, in Holborn, for the first time, in March, 1771, but in twenty years the members had increased from a very few to sixty-five. This society was dissolved in May, 1792, in consequence of unhandsome and ungrateful conduct by one of the members to Mr. Smeaton; and before the new society met, April 15th, 1793, Mr. Smeaton was no more. The first meeting of the new society consisted of Messrs. Jessop, Mylne, Rennie, and Whitworth; and they soon formed three classes of ordinary and honorary members, the last honoraries being operative men, and the first honoraries consisting of noblemen and gentlemen, and others not engineers or mechanics. One special object of this society was to do honour to Smeaton, the drinking of whose health was the first business of every dinner. Smeaton did not publish his Reports, valuable as is the matter they contain; but a committee of his admirers undertook this business after his demise, bearing all the expense of publication, and handing over whatever might accrue to his representatives. This committee consisted of Sir Joseph Banks, Captain Joseph Huddart, and Messrs. Jessop, Robert Mylne, and John Rennie. These gentlemen retained the original language of Mr. Smeaton, although much of it is very peculiar in the style, but it is far more expressive than if they had attempted to make it more classical; and when the importance of the subjects is considered, Smeaton's Reports is the best book that we possess upon civil engineering, and one which every young engineer should study with the greatest attention.

THE CALEDONIAN CANAL.

THIS work has been a most expensive one to the public; and the situation of it is excellent, but it is badly done, especially in the approaches, where there is not a lamp, beacon, buoy, or any other means of pointing out the fair way to vessels. The locks are also badly worked; and, indeed, the only thing carefully looked after appears to have been the expense, which, as we have said, is very heavy, and has fallen wholly on the public, to the amount of nearly a million sterling, which sum will be exceeded before the works are put in a useful state. As the following Report from Captain Parry, lately delivered to the Government, is rather imperfect, we shall give a notice in our next from original information obtained on the spot.

COPY OF A REPORT RECENTLY MADE TO THE TREASURY, BY CAPTAIN SIR W. E. PARRY, R.N., ON THE CALEDONIAN CANAL.

[After detailing at some length his preliminary proceedings, by surveying the whole extent of the Canal, and addressing a series of 24 queries to a number of persons best qualified to give information on the subject, Sir E. Parry proceeds:]

Having thus stated the means employed for obtaining information, I proceed to report what appears to me to be the result fairly deducible from the facts collected and the observations made in the course of this inquiry. The questions referred to me are two; namely,

I.—*As to the Navigation of the Caledonian Canal, and its Approaches by Sea.*

II.—*As to the Probability of the Canal being used to any considerable Extent, if the projected Improvements be carried into effect.*

I.—*As to the Navigation of the Caledonian Canal, and its Approaches by Sea.*

1. THE NAVIGATION OF THE CANAL.

THE Caledonian Canal consists of 22 miles of canal (strictly so called) out of the 62 miles of navigation from one sea-lock to the other, usually known by that name. The remaining distance of 40 miles is through lakes, narrow in proportion to their length, but in most places having an abundant depth of water very near to the shores for ships of any size. The principal exception to this latter rule occurs in Loch Oich, which is the summit level of the whole navigation, and about 94 feet above that of the sea. So far as the lakes have yet been surveyed (for I cannot discover that any regular marine survey has been made), there appears to be a few places where vessels may anchor near the shores, the water being generally much too deep for this purpose. The exceptions in this respect occur for the most part near the estuaries of some of the streams which are discharged into the lakes. The winds almost invariably blow directly along the line of the lakes and canal, so that what seamen call "a slant of wind" is never to be expected. This circumstance, as well as the violent gusts of wind occasionally experienced, is common to all narrow valleys and arms of the sea, having high hills on each side.

The circumstances just described would, I apprehend, be sufficient to satisfy any seaman, that at the time of the formation of the Caledonian Canal, when 40 miles of this navigation could be accomplished only by the power of the wind, with a very contracted space for "turning to windward," and very doubtful means of anchoring, it would have been most imprudent to risk a vessel of any considerable tonnage in these lakes, even if the depth of water had been sufficient throughout, which it never has been to the present time. Indeed, when on the spot, I could not help wondering, not that so few had ever availed themselves of this navigation, but that any had ever been bold enough to attempt it, even with vessels of 100 tons.

If the *security* of vessels using this navigation has hitherto been doubtful, so also has the *time* in which it might be effected, under the adverse circumstances of unfavourable wind, thick weather, or long dark nights. Under such circumstances, the principal ones which would induce a seaman to prefer the Canal to going "north about," it has hitherto been quite impossible to calculate within any reasonable limit upon the time likely to be occupied in passing from sea to sea; and, upon the whole, I

can perceive little or nothing to have rendered this navigation desirable, beyond the additional security to vessels *lying idle* in any portion of the artificial Canal, when compared with the Pentland Firth, and its adjacent ports.

I conceive, however, that steam navigation has entirely altered the state of this question in a nautical point of view, obviating every difficulty, both as to security and speed. If steam-tugs of moderate power were employed on the lakes, and a sufficient number of proper horses provided for towing in the Canal, I am of opinion that the time occupied in passing from Fort George on the one side to Corran Ferry on the other, need not, except in extraordinary cases, exceed 48 hours in summer, and 72 hours in winter. The details of the calculation on which I found this opinion are contained in a letter from Mr. May, in the nautical part of which I entirely concur. I believe it may be safely asserted, that no strength of unfavourable wind, short of that which would, under other circumstances, and in other localities, render it imprudent to get a ship under way, need create any extra detention in passing through the Caledonian Canal; while, in a great variety of instances, a ship might be got through quickly and in perfect safety, when it would be impossible to effect a passage *by sea* at all from one coast to the other.

There remains, however, one very important consideration, affecting in some degree the question of speed, if not of security, in the passage of the Canal: I allude to the formation of ice in some parts of this navigation during a portion of the winter. The facts I have collected on this subject are briefly as follows: ice seldom or never forms in any part before Christmas, and it rarely takes a continued hold of the waters so soon. By the end of February this obstruction is considered at an end; once only, in the course of many years, has it extended into March, at which season strong winds usually prevail, with open weather. The ice almost always begins to form on the Canal Reach westward of Fort Augustus, between Loch Ness and Loch Oich; afterwards on parts of the Canal Reach between Loch Lochy and the sea at Corpach; and, last of all, towards the eastern end of the Canal. Loch Ness and Loch Lochy, from their great depth of water, have never been known to freeze. Loch Oich, being in many places shallow, is partly frozen over in *hard* frosts, and entirely so in *very intense and long-continued frosts*. It may be mentioned as a fact, indicative of the high temperature of Loch Ness during the winter, that of the seven miles of canal between it and the sea, a distance of four or five miles next to the lake is scarcely ever frozen, in consequence of the leakage from it into the canal of water at a comparatively high temperature. The average formation of ice in a single night, in the reach westward of Fort Augustus, may be taken at half an inch; in *very intense* frosts, with calm weather, it has amounted to an inch. On the other hand, a continuance of even moderate winds has prevented the formation of any ice at all for a week together, notwithstanding constant and severe frost. In cases where the ice has been for some time *undisturbed by traffic*, it has increased to a thickness of four to six inches. In some places (but this is an extreme case only) it has been known to reach a foot. This occurred in 1838, when, however, most of the river harbours in the kingdom were blocked up for nearly the same period. During the last 13 years, the only serious obstructions from ice occurred in the beginning of 1833, 1838, and 1841 respectively. The navigation was interrupted from the 11th of January to the 6th of February 1833; from the 16th of January to the 9th of March 1838; and from the 6th to the 30th January 1841.

Having maturely considered these facts, I am confidently of opinion, that by the judicious use of simple, and not expensive means, such as a regular and increased traffic would fully justify, there need not be, except in extreme cases, a single day's detention, on account of ice, in the course of the year. On Loch Oich, a steam-tug having her bows armed with iron, and passing through the "young ice" occasionally, whether there was any thing to tow or not, would be of great use in keeping the channel open. On the canal-reaches, ice-boats, dragged along by horses or men, would effectually answer the purpose; and the mere circumstance of a regular and constant traffic would in itself go far towards removing the obstruction altogether. I may add, that an abundance of men, thankful for such employment in the winter, might at all times be collected to assist in this operation, at a short notice and upon reasonable terms.

2. The Navigation of the Approaches by Sea.

On this important part of the subject, we have the evidence of two very able nautical surveyors, Commanders M. A. Slater, and Charles G. Robinson, R. N., who have been employed by the Admiralty in making actual surveys of these approaches; the former in the Murray (or Inverness) Frith in 1837; the latter, as already mentioned, in the autumn of 1841, near the south-western entrance to the Canal. The evidence of Commander Slater before a Committee of the House of Commons in 1839, is already before the public, in the Minutes annexed to their Report. In addition to this, Commander Slater has recently transmitted to me a tracing of the whole of his work, extending to the mouth of the Canal; and on a careful examination of this officer's survey, to which may be added the evidence of the two pilots already mentioned, and that contained in some of the replies to query 10, I cannot hesitate to give it as my opinion that, by employing the *ordinary precautions*, such as are necessary for entering almost any harbour in the kingdom, but which are now almost entirely wanting in this Firth, there would be no difficulty in entering or leaving the Caledonian Canal on this side.

The precautions to which I allude are,—the erection of proper light-houses, which need not be numerous, large, or expensive; the placing of a few buoys and beacons; the employment of competent and authorized pilots; and the construction and publication of correct charts. I conceive that with these facilities the difficulty of this approach would be vastly less than is encountered daily by a multitude of vessels entering or leaving the Thames.

The foregoing remarks refer more especially to the degree of *security* to be expected in this navigation. In order likewise to ensure *speed*, it would be essential to have a steam-tug stationed between Fort George and the Canal, to be used in case of need, and also to establish some simple signals to notify when this assistance might be required.

The remarks I have offered in reference to the navigation of the Inverness Firth, apply equally in almost all respects to the other. I see no difficulty in this navigation if the ordinary advantages of lights, buoys, and beacons, together with pilots and charts, were provided. The only difference appears to me to be, that the assistance of a steam-tug would be even more indispensable here than in the Inverness Firth, on account of the rapidity of the tides at Corran Ferry.

In addition to the Report of Commodore Robinson, which is in all respects favourable to the navigation, I have given in the Appendix the information obtained from the two pilots who accompanied me.

With reference to certain supposed difficulties in this western navigation, alluded to by two of my informants, I communicated with Commander Robinson on these particular points. The replies of that officer appear to me entirely to obviate all difficulty as to those supposed dangers.

I refrain from entering upon the question as to the number and position of the lights, buoys, and beacons required for the sea navigation at each end of the Canal. These details are discussed in the reports of Commanders Slater and Robinson, and would be easily decided by the proper authorities in such matters. The surveys and reports alluded to are lodged in the Hydrographical Office of the Admiralty, and will at any time form valuable *data* for this purpose.

II.—*As to the Probability of the Canal being used to any considerable Extent if the projected Improvements be carried into effect.*

On a general review of all the information now obtained, the only tangible objection seems to me to amount to this, that, without much calculation on the subject, the masters of vessels often prefer going north-about, on the plea of avoiding the Canal dues; and that, in this respect, ship-owners and merchants are much in their power. The objection, if so it may be called, cannot be better stated than it was in the evidence, before alluded to, of Commander Slater in his reply to question 94: "If," says he, "it is left to the masters of vessels, in many instances they will prefer losing 14 or 16 days to go round the land, rather than come through the Canal, on account of the dues."

I have also found, in many ship-owners, a considerable disposition to avoid the *direct* payment of money in the shape of dues, preferring to run the chance of a good passage north-about; and it must be allowed that the hitherto inefficient state of the Canal has tended very much, and very justly, to confirm them in that view of the matter. It is essential, therefore, to a just and candid consideration of the subject, that this objection of expense be gone into at some length. The question must, of course, in all such cases, resolve itself into one of pounds, shillings, and pence; and it is on this ground that I offer the following considerations.

The items of expense to be *paid down* for going through the Caledonian Canal, supposing it to be made efficient, would be,—

1st. Canal dues, *now* amounting to one farthing per ton per mile, or fifteen pence half-penny per ton for the whole distance of 62 miles.

2nd. Insurance of vessel and cargo.

3rd. Light dues.

4th. Pilotage.

The three last items apply also to the passage north-about as money to be *paid down*.

There is, however, another essential element in the calculation, though not involving a *direct* payment, namely, the number of days' wages, victuals, and wear and tear, which, on an average of summer and winter, and considering all other circumstances, a vessel may expect to save by

going through the Canal, compared with the passage north-about. From the answers I have received to the question bearing on this point, we cannot perhaps be very wrong in assuming the average ($9\frac{6}{7}$ days, or $9\frac{1}{2}$ in round numbers) as a fair estimate of the truth, which, in my own individual opinion, it does not exceed.

The following is a comparative calculation of the expense of ships of 200 and 300 tons passing through the Canal, and going north-about.

	FOR 200 TONS.	FOR 300 TONS.
AMOUNT SAVED	£. s. d.	£. s. d.
Nine and a half day's wages, victuals, and wear and tear	25 15 4	37 9 8
Difference of insurance, being the mean of summer and winter, in the proportion of 24*s*. 1*d*. to 33*s*.	22 5 10	44 11 8
Amount saved £.	48 1 2	82 1 4
EXPENSE INCURRED.		
Canal dues, at one farthing per ton per mile	12 18 4	19 7 6
Difference, in favour of the Caledonian Canal	35 2 10	62 13 10
Ditto, supposing the dues to be *doubled £s*	22 4 6	43 6 4

It appears to me, from this calculation, that there is reasonable ground for supposing that the passage through the Canal would be less expensive than that north-about, even if the present dues were doubled.

In addition to this, however, it is important to bear in mind, that in the foregoing computation no account is taken of the saving *to the merchant* which a quicker and more certain passage must often produce. I need scarcely repeat the trite observation, that in many, if not in most, commercial transactions "time is money," and although, from the ever-varying circumstances of the case, we cannot reduce to actual figures the saving thus likely to be effected, persons interested in such matters cannot fail very highly to appreciate the advantage of being able to reckon with increased confidence on the rapid transmission of cargoes from port to port. Some evidence as to this fact will be found in many of the replies to my queries; but perhaps none is more striking than that which relates to the importance of sowing-linseed arriving in Ireland from the Baltic without delay in the autumn; every failure of this kind involving not only a serious loss to the merchant, who, as a last resource when it arrives too late for sowing, is obliged to sell it for crushing, but the still more grievous disappointment of losing the sowing season for that year altogether. This subject is alluded to in a letter from Messrs. Gany & Curtis, forming Appendix No. 5 to Mr. Walker's Report on the Caledonian Canal, dated the 7th of June 1838.

If the facts now adduced, and the calculations founded on them, be correct, I cannot avoid coming to the conclusion that, if the Caledonian Canal were made efficient, it would very shortly be used by almost all those coasting vessels which now pursue a northern route in trading between the eastern and western coasts of England and Scotland, or between the former and the ports of Ireland; by nearly the whole of the vessels, whether British or foreign, coming from the Baltic, especially late in the season, and bound to ports on the western coast of this island, or to the ports of Ireland; and not unfrequently by vessels trading between our north-eastern ports and North America or the West Indies.

I am further of opinion that, in case of war with any nation fitting out fast-sailing vessels or steam-vessels, as privateers, the passage by the Caledonian Canal for merchant vessels would almost wholly supersede that by the Pentland Firth; since a single efficient man-of-war of no great force would suffice to give protection to each approach to the Canal by sea. In case of war, also, it can be scarcely doubted that the present difference of insurance would be considerably increased in favour of the Canal.

According to my judgment, Hull on the east and Liverpool on the west coast, and every port of England and Scotland to the northward of these, is more or less interested in the completion of the Caledonian Canal, and perhaps in a still greater degree some of the pricipal ports in Ireland, particularly Dublin, Belfast, Londonderry, and Sligo. An inspection of the shipping list of vessels that have lately used the Canal, even in its present wretched state of inefficiency, will abundantly confirm this fact; and there can be little doubt that all these ports would derive additional benefit from this passage, and therefore furnish additional traffic for it, in proportion to the increased facilities afforded by the completion of the Canal.

Indeed, there is moreover some reason to believe, that in that case vessels belonging to some of the English ports to the southward of Hull and Liverpool, would prefer the passage through the Caledonian Canal to that by the English Channel, on account of the heavy dues chargeable by the latter route.

I must not, however, omit to notice, as bearing upon this subject, that there are certain modes of conveyance for goods between the east and west coasts of Great Britain, most of them established at a comparatively recent period, which, as relates to the coasting trade more especially, must be considered as in some degree rivals, not only to each other, but also to the Caledonian Canal. These are—

1st. The Forth and Clyde Canal, between Grangemouth in the Firth of Forth and the River Clyde.

2d. The Edinburgh and Glasgow Railway, soon about to be opened, and probably to be continued to Leith.

3rd. The Newcastle and Carlisle Railway.

4th. The lines of railway between Hull and Liverpool.

It may be a matter for consideration whether these several communications between our two coasts will, upon the whole, have the effect of lessening the demand for freight in vessels of such a tonnage as might pass through the Caledonian Canal in its efficient state. My own belief is, that they will not in any material degree; for, independently of the fact, which experience has generally proved, that increased facilities create an increased demand, it is probable that no great quantity of heavy goods will be conveyed by railway, except in cases where, from the perishable nature of the commodity, or other temporary circumstances, a rapid conveyance to market, almost at any price, is of urgent importance; while, with respect to the Forth and Clyde Canal, there is reason to suppose that merchants would often be glad to avoid the delay and expense of trans-shipping goods into the small vessels (drawing from eight to nine feet water) which can alone navigate that Canal, if larger vessels could ensure a quick passage from coast to coast. I cannot, however, entertain a doubt that ample traffic will be found for all these modes of conveyance.

Having, in addition to the evidence comprised in the replies to my queries, received a few letters from parties whose judgment is entitled to particular notice, I have deemed it right to insert them in the Appendix. I may here state, that I have purposely avoided referring, in this Report, to several valuable opinions with which I was favoured by intelligent and influential gentlemen at Inverness and in its neighbourhood; because I judged that in a public document those opinions, whatever conviction they may have carried to my own mind, might be received with some distrust, as unfit to form the basis of any decision on this subject, on account of the unquestionable local interest of Inverness in the completion of the Canal.

From the considerations I have now had the honour to offer, I submit that the following inferences may be justly drawn:—

1st. That the Caledonian Canal, from its hitherto imperfect state, including the small, variable, and uncertain depth of water, and the entire absence of the requisite facilities either for getting through the Canal itself, or for navigating the approaches to it by sea, has never yet had a fair trial of its capabilities, and, consequently, of the extent to which it may be used with advantage by the trade of the country.

2d. That if the Canal and its approaches were put into the state of efficiency contemplated in this Report, the passage through it would be cheaper (*even at double the present amount of dues*), much more speedy, and by far more secure, than the passage by the Pentland Firth.

3d. That, on this account, a very large proportion of vessels now pursuing a northern route round this island, would use it in preference to the Pentland Firth, and perhaps some of those which now go through the English Channel.

4th. That, in case of war with certain nations, the Caledonian Canal would be used by such vessels to a still greater extent,—perhaps almost exclusively,—on the ground of *increased* comparative cheapness, speed, and security.

I must, however, express my opinion, that nothing short of *complete efficiency*, affording a moral certainty of accomplishing the passage without delay, will at all answer the desired purpose. Every thing must be placed and maintained on such a footing, that the commander of a ship running

for the canal may do so with *entire confidence* of finding all the facilities recommended in this Report.

Should it be decided to complete the Caledonian Canal, I need scarcely remark upon the expediency of fixing the dues *at first* at a rate somewhat below the amount which it might afterwards be found reasonable to exact; and I should especially recommend that no "passing toll" (*i. e.*, a toll to be paid for passing, *without using* the canal) be demanded, as in the case of certain harbours in this country,—a charge of which some of the parties I examined have a considerable apprehension. In this, as in all other such undertakings, there is a point equally removed from an exorbitant demand, amounting to prohibition, on the one hand, and an unnecessarily low and unremunerating charge on the other. The experience of one, or, at the most, two years, would satisfactorily determine this point; and I confidently believe that, in proportion as the reasonable objections now existing to the extensive use of the canal, on account of its imperfect condition, were removed (for which, under an improved state of things, a few months would be sufficient), the traffic upon it would be such as to leave nothing to regret on account of its completion.

Having thus, to the best of my ability, reported on the points referred to me for inquiry in the nautical department of this question, I venture in conclusion to express an earnest hope that the reports which their Lordships may receive relative to the other departments of this great work, may be such as to justify Her Majesty's Government in deciding on its completion.

It may be adduced, as an obvious argument in favour of this decision, that an actual necessity exists for laying out, and that without much delay, a very considerable sum of money, merely as a security against the imminent and fearful risk of an incalculable amount of damage to property, and perhaps destruction of life, arising from the present dangerous state of some of the works. I might urge, as an equally obvious and even more forcible argument, the still larger expense required to abandon the canal altogether, amounting, as I understand, to full one-third of Mr. Walker's estimate for completing it. But, important as these facts undoubtedly are, in deciding on this question, I cannot but look upon the Caledonian Canal as involving considerations and affecting interests of a much higher and more permanent character than these; feeling confident that the completion of this splendid national undertaking, and its maintenance in the state of efficiency and usefulness of which it is capable, cannot fail to add materially to the facilities for carrying on a large and valuable portion of our trade, and therefore to prove a solid and lasting advantage to the commercial interests of the country.

EXTRACTS FROM APPENDIX.

OBSERVATIONS by Mr. *May* on the probable Time required for passing through the CALEDONIAN CANAL, if rendered efficient, assuming the steady continuance of a reasonably stiff head wind, and the Ship or Ships (say 300 Tons) to be taken in tow from without Fort George Ferry on the east, to without Corran Ferry on the west; supposing also the chances of the Tides on the two Estuaries being in favour, or otherwise, to counterbalance one another.

My calculation of time is as follows:—

——	MILES.	HOURS.
From below Fort George to the canal by steam..	10	3
Trackage by horses to Loch Ness.....	6½	3
Seven locks to be passed in this distance	—	2¾
Loch Ness by steam.....	24	7
Trackage by horses to Loch Oich.....	5	2½
Seven locks in this distance	—	3
Loch Oich and Loch Lochy by steam.....	16	5
Double lockage for steam tug and vessels through two Laggan locks (sometimes used as one) ..	—	1
Trackage by horses from Loch Lochy to Corpach	7	3½
Twelve locks in this distance	—	4½
From Corpach sea lock to beyond Corran Ferry ..	10	3
In all.....		38¼

Or say 40 hours. I conceive it is quite possible for vessels in summer to accomplish the distance within this time, as it will often suit to take the lakes and estuaries at night, so that not any delay may occur, and in moderate weather in winter, when there is moon-light, it may be accomplished in little more; but, making allowance for all contingencies, such as waiting for the tugs, &c., I am disposed to estimate the average time in summer at from two to three days, and in winter from three to four days; calms or partial fair winds would, of course, proportionably shorten the time.

INFORMATION obtained on the spot relative to the Navigation of the Eastern Approach to the CALEDONIAN CANAL, from Mr. *Walter Strachan*, Master of the Schooner "London," who has been engaged in Vessels sailing to and from Inverness and through the Canal since 1805, and from Mr. *Andrew Bowman*, Master of the "Maid of Morven" Steam-vessel, who has been similarly employed since 1826.

There are neither lights, buoys, nor beacons in the Moray Firth: there is nothing, in short, to go by but leading marks; the firth is a dangerous place in misty weather, or dark nights.

To commence with the navigation between Fort George and the basin of the canal: the south channel is the one principally in use; during all the time that Captain Strachan has been coming to Inverness, he has only used the north channel (upon which at low water spring tides there is not more than seven feet and a half) twice; it was on each occasion because he wanted to unload part of his cargo at Rosemairie (a village on the north side of the firth); the bank that runs between both these channels has from seven to eight feet water upon it at ordinary low water.

First consideration:—As to Pilots: At the present time there is only one regularly employed; if the canal were put into a state of complete repair and efficiency, there would be no difficulty in finding respectable men who would be willing to be examined for a pilot's license; Captain Bowman said, that, under such circumstances, he should wish to be appointed one; the best way to come up in thick weather is, to keep into the north shore, and, as you approach Inverness, get to south-west of the firth; this is the course to get most regular soundings in; the lowest water at spring tides in the channel is from 12 to 13 feet; there is excellent riding ground at Cambeltown Bay (just within Fort George), in from five to seven fathoms water, with blue clay bottom; the anchorage opposite Kessock Ferry is from 12 to 14 fathoms, with excellent blue clay bottom.

Second consideration.—As to Lights: The lights that would be necessary for the Moray Firth are, first, one (a stationary light) upon Stotfield Point or Head; one (a stationary light) upon the Sectors of Cromarty; one on Chanonry Point, and one on Fort George, as two leading lights; they would be a leading mark up the south channel; the lights should all be small, and, if placed in the manner suggested, would be quite sufficient, as far as lights are concerned, for the navigation without and within Fort George.

Third consideration.—Beacons and Buoys: Outside Fort George the beacons and buoys required are, a beacon for the bank called the Middle Bank, and two large buoys; the beacon to be on the north-eastern end; one buoy on the north elbow, and the other on the south; it would also be useful for vessels coming down to have one upon the west end; a buoy would be required on the shoal of Whitness Head or Whiting Head, which is a dangerous shoal; the channel on the north of the Middle Bank is the best; it is quite safe, and there are never less than five fathoms at any time; the north shore is all bold.

Inside Fort George: Two buoys upon the Middle Bank, one upon each end of it; a bank runs out below Culloden Point, upon which a buoy would be required; there is a small shoal called the Mucklemee, opposite Kilmore, upon which there should be a buoy; a beacon would be required upon the shoal off Longman Point: with the above beacons and buoys, a ship of 500 or 600 tons could easily come up to the canal; but even without reference to the canal, it is due to the town of Inverness to place these lights, buoys, and beacons.

Fourth consideration.—As to Steam-tugs: If the canal were rendered efficient for vessels drawing as much as 17 feet water, it would be required to have a tug from Fort George up to the canal; in calm weather the tug might take or come for ships as far as the Sectors of Cromarty; it should be a strong one, of not less than from 80 to 100 horses power.

With reference to steam-tugs in the canal, Captains Strachan and Bowman were of opinion, that one would be requisite for Loch Dochfour and Loch Ness; the latter is 22½ miles long; there is no sea in it, but a short chop in a gale of wind; the steam-tug for this part of the work ought to be about 50 horses power; the tug for Loch Oich would also answer for Loch Lochy, as, in consequence of there being only one intervening lock, it could go through that portion of the canal; this tug should be of about 40 horses power; the steam-tugs within the canal must not be wider than 36 feet, the breadth of the locks being 40 feet; the tugs to take at each trip as many small vessels as could be contained in a lock at a time.

INFORMATION obtained on the spot relative to the Navigation of the Western Approach of the CALEDONIAN CANAL, from Mr. *Alexander*

M'Ewen, who has been engaged piloting Vessels through the Canal and Loch Eil during the last six Years, and from Mr. *John M'Glucus*, a Pilot for the last ten Years.

The channel to the canal lies to the north of the islands situated above Camuscagaul Bay. There are four islands, which are all to the southward of the channel; two of them are beyond the navigation to the entrance of the canal; the anchorage within Camuscagaul Bay is very good; there is a rock outside it, upon which it would be necessary to place a beacon; three or four buoys would be required to mark the banks on the south side; the longest bank is off Fort William; there are from 10 to 11 fathoms of water in the channel opposite the bay; at spring tides the stream runs at the rate of four knots an hour in it; there is not the slightest difficulty in the navigation, and there is good holding-ground on both sides; gales sometimes blow hard from the westward in the loch, but that does not signify, for once a vessel is in Camuscagaul Bay, she will ride out any gale; the wind is not always up and down in this loch; opposite the fort the channel is about seven fathoms; from abreast of the pier down the loch there are as much as 80 fathoms of water; the ebb tide always runs to the north side of the loch; the rock on the south side opposite to Inverscaddle (Inverscaddle is on the north side of the loch), is always uncovered, and is close inshore; there is a bank on the north side of Corran Ferry, but nobody ever goes near it.

ARRANGEMENTS required to render the Navigation of the CALEDONIAN CANAL and its Approaches speedy and secure.

1.—THE canal to be deepened to 17 feet water throughout; (the difference of expense between 14 and 17 feet being, as I understand from Mr. May, comparatively small, the greater depth is clearly preferable.)

2.—An efficient steam-tug of about 80 horse power to be stationed at each sea approach, one of about 60 horse power on Loch Ness and Loch Dochfour, and one of the same power for Loch Lochy and Loch Oich; besides these, at least one spare steam-tug of each power would be required, to be employed during the repairs of any of the others; and the parts of the machinery belonging to one vessel should be made to fit as many of the others as possible, in order to increase the facility of repairs. (The screw propeller, if brought successfully into operation, would evidently be advantageous in all these vessels.)

3.—A small establishment to be maintained near each end of the canal for making minor repairs, and two or three coal depôts at convenient stations.

4.—Sufficient horses to be always ready for towing.

5.—Lights to be placed for the navigation of each approach by sea; smaller and inexpensive lights at each entrance of every artificial portion of the canal, to guide ships when running for these.

6.—Buoys and beacons to be placed as usual in such navigation.

7.—Warping-buoys to be laid down near each entrance of every portion of the canal for warping in and out; these should be very securely moored, so as to allow a vessel to bring up and hang on by them, when running for the entrances under sail with a stiff breeze.

8.—Guard-chains to be stretched across each entrance (as already adopted in some places) to protect the gates from injury by ships approaching incautiously.

9.—Ice-boats, tools and ropes to be provided in winter, for breaking and clearing away the ice.

10.—Surveys of the sea-approaches, and of the lakes, with the usual sailing directions, to be published.

N.B.—A marine survey of the lakes is required to be made, and might be completed by a surveying party from each end, in the course of one summer.

11.—Proper pilots to be examined and licensed for each approach by sea, and moderate rates of pilotage established.

12.—Every facility to be given for continuing the progress of vessels through the canal and lakes *at night*; and as little dependence as possible to be placed on the assistance of the crews in opening and closing the lock gates.

REVIEWS OF BOOKS.

Villa Rustica: selected from Buildings and Scenes in the vicinity of Rome and Florence; and arranged for Lodges and domestic dwellings. With Plans and Details. By Charles Parker, Architect.

THIS work cannot fail in proving highly instructive and useful to young artists, even though they have visited the scenes, and seen the materials from which it is made up; and this is proved by the rapid sale of the first and second parts.

The time which young artists, in the days of their studying, can afford to spend in the vicinity of Rome and Florence, and the other great localities of Italian Architecture, is generally too short for enabling them to enter into the proper feeling of the subject; and besides this, the fashion which has long prevailed in Britain carries them more immediately and directly to the classical remains, and makes them overlook the buildings of regenerated Italy, during the period of its splendour in the middle ages. Now though, as subjects of abstract grandeur and magnificence, the classical remains of Rome and the other great cities of Italy are eminently deserving of attention; yet, considered in a practical point of view, and as models for dwellings and other structures of the present time, they are vastly inferior to the buildings of the middle ages, many of which remain quite perfect. Copying the buildings of the ancient Romans would be much the same as copying their dress, their religious ceremonies, their modes of warfare and warlike arms, or anything else about their general conduct and economy. The habits of nations, and along with these their ideas of taste and comfort, change with the lapse of years; and when once any peculiar set has gone out of date, it would be bad taste to restore it as part of the popular economy, how much soever we might admire it as a remain of antiquity. Such dwellings of the classical Romans as remain come under this category. They have not only gone out of date as wholes, but the parts of them have ceased to have much use even as Italian buildings, and much less so as British ones. According to our notions, the builders of these dwellings studied ornament in their structures much more than comfort; and they bestowed, especially in the neighbourhood of the capital and other great cities, much more expense upon even the dwellings of the humblest of the people, than would be borne by the erectors of the suburban villas in our own times. The reason of this is obvious: the Romans did not ever by arts and industry, exercised in their own country, the whole of what they expended in its decoration. They plundered the inhabitants of the countries which they conquered to a much greater extent than any other people who ever lived; and Italy was the grand centre to which this plunder was brought. The extent of ground which they thus plundered was immense, and the spoils brought to Rome corresponded. But both contributed to the downfall of the Roman Empire and people; and, had they been less grasping in their conquests, and less expeditious in their spoliations, they certainly would have rested much longer as a people. But as the boundaries of what they conquered extended, they became difficult to maintain and defend; and the spoils of nations which were brought in immense quantity to Italy, gradually brought down the warlike character of the Romans, at the same time that it made them luxurious and vicious.

In modern times, in Britain especially, the people do not, even when most triumphant in war, enrich themselves with the spoils of other nations. The moderns, and the British especially, content themselves with the glory of the war; and in order to share amply in this glory, they have sometimes been forward to join in strifes in which they had no real interest, and purchase this glory at a large expenditure of treasure as well as of blood. In the last war, for instance, the sum expended by Britain in the purchase of glory was quite unprecedented, and all that was had in return for it was a few common tattered flags, to show on parades and flaunt in halls of public assemblage. Our villas and buildings of all kind are erected

at our own expense; and, in our dwelling houses especially, comfort, the very name of which was unknown to the Romans, is the grand end we have always in view.

It must be granted that in this we are far more independent and far more secure than if we were making ourselves fine upon the plunder of our neighbours, but this very circumstance cuts down that decoration which the Romans lavished upon the dwellings even of the humble classes,—or, if we have any countervailing circumstances, it is in the comfort which the interior of our dwellings affords, and this is far better and more durable than the mere gorgeousness of the exterior. In our public buildings we copy the architecture of classical Rome; and we do this, probably, in a manner which is so servile, that it does not agree with the character of our country, or the nature of our climate; and were we implicitly to copy their villas and cottages, it would make the state of things still worse.

When the Italians revived the arts, and the art of building among the number, they did not revert to the structures of ancient Rome. They conceived a style of their own, something intermediate between the voluptuous style of the ancient Romans, and the "necessity" style of the English. Even this Italian style is too ornate for the climate of Britain, except in very particular situations. That style may do for lodges at the entrances of very magnificent parks, or in any situation in which it is an appendage to splendour; but, even in a suburban villa, if that is on a small scale, it excites ideas of the ludicrous, just as such ideas are excited by laying out a few rods of a garden after the model of a park of a thousand acres, But if there are those feelings of the ludicrous inseparable from suburban villas in the Italian style, the case is far worse in the country; and such a villa upon Salisbury Plain, or in the wide expanse of a level agricultural district, would have the appearance of "something stolen or strayed," and not part and parcel of the general scenery, and harmonising with the rest. In the case of charity schools, of which Mr. Parker gives a good many specimens, matters are still worse. We know the means by which such schools exist, and we also know how very imperfect the education at most of them is; and, therefore, we could not contemplate their external decorations, without adverting to the very inferior state of things within, any more pleasurably than we could contemplate the ornamented hut, in which the labourer had toiled during the best of his days, and from which he were now to be removed to the Union workhouse.

But if there is incongruity in such matters, Mr. Parker is not to blame for it. He is not the maker, the fashioner, or the director of society. He was born in it like all the rest of us, and he cannot control its movements, whether he approves of them or no. In his works he has brought forward a great number of beautiful and tasteful designs; the rapidity with which the first and second parts sold off, is the best evidence of the estimation in which they are held by architects. They afford to these a vast and valuable quarry of materials; and this quarry they will not fail to work in all situations where the materials can be used with propriety. Besides the advantage of the Italian models, Mr. Parker has shown young architects how to compile and modify their structure, when their invention is naturally scanty, or has been run almost dry; and in this he has probably done more substantial service to the craft than in bringing forward the models themselves.

Churches in the Division of Holland, in the County of Lincoln, with Illustrations, by Stephen Lewin, Architect. Parts 1 and 2, Algarkirke, Benington and Bicker. Morton, Boston; Simpkin and Marshall, Ollivier, Weale, London.

If we examine England in its whole extent, we do not fail to discover that the division of Holland, occupying the south-east of Lincolnshire, is pre-eminently the land of churches. There are few towns, and therefore the churches to which we refer are in far the greater part village churches; and of them we may say that they are quite unrivalled by any other ecclesiastical structures in the kingdom. The district is situated wholly in the fens, and in the most humid part of them. From this situation it is natural to suppose that it should be pre-eminently the region of geese and of wild fowl of all descriptions. But we are somewhat surprised to find that parsons, or at all events parish churches, are as plentiful as geese, wild ducks, or widgeons, and that only the first of these rival them in being conspicuous. But while the churches are at the present time so very conspicuous, we are not sure that clergymen are not equally so. In former times, however, this must have been the case, for our forefathers were not so prone to build useless churches as we are at the present time. These edifices, though beyond all comparison superior to the modern parish churches, are seldom specimens of pure architecture, but still that of the greater part of them is in general good; and they are of ample dimensions, far exceeding the churches of the present time, even the new ones, and as large in proportion to the present population. These churches are rendered more conspicuous by the naked ground on which they stand, there not being a hillock or any other inequality to break the dullness of the surface. In some places, indeed, there are trees, but some are destitute of even these, and, in consequence, they look as dismal as can well be imagined. When, indeed, we compare the country and the churches together, we cannot help feeling that we are amid the ruins of a country which has once been thickly peopled, but is now, in so far as the bolder features are concerned, a bleak and marshy wilderness. Of the three churches which are figured in these two parts—for only two of the three are described, Algarkirke is an exception to that perfect bleakness of situation to which we have alluded, at least in so far as trees in the front of it are concerned. These give it a rich and picturesque appearance, which harmonizes well with the nature of the structure itself. That structure is of ample size; and, though the architecture cannot be called either rich or chaste, it suits well with the situation, and has not many rivals among parish churches. It is built in the form of a cross, only the portion to the eastward of the transepts and the tower is called a chancel in ordinary churches, and a choir in cathedrals: generally speaking, too, a church does not terminate eastward in a lodge chapel as in cathedrals; but, in other respects, the appearance of the exterior is nearly the same. With a single exception, all the parts of this are in the old style of building, and that exception is the chancel, which owes its dissimilarity more to the repairs which it has undergone than to anything else, the decayed parts having been repaired with brick-work, whereas the church, generally speaking, is stone. In the view which is given in the present work the bricks are fortunately concealed, so that here at least the anomaly is hidden. Of the other parts, the nave with its aisles are in what is called the transition style of architecture, the windows consisting of antique parts en-

closed in a pannel. The transepts are in older, and consequently in better style; but still, though there are none of the graces of architecture in the building, it is altogether rich and in good keeping. It contains some monuments which are understood to be very old, the most celebrated of which, both for its antiquity and its legend, is that which is understood to be to the memory of the brave Earl Algar, who is reported to have fought so gallantly against the Pagan Danes, but ultimately to have been worsted. There are many of these ancient monuments, said to be to the memory of Saxon warriors who fought against the Danes, scattered up and down over the country; but, to say the least, the greater part of them are doubtful. Of less ancient monuments there are a great many in Algarkirke; and as they bear their inscriptions literally upon them, their authenticity is more clearly established; but, as its doubtful age is one of the most interesting circumstances connected with a monument, these modern ones are comparatively of minor importance. This church is celebrated for its ministers, one of them having been the famed St. Swithin, now the Patron Saint of Winchester Cathedral, and another William of Wamfleet, one of the many builders of that edifice. On account of them, more than of the monument of Earl Algar, there is no inconsiderable interest in the parish church of Algarkirke.

Benington, the second in order as mentioned, has got no such story to tell as Algarkirke; but it is a fine structure, though perhaps not so picturesque as the former. The nave is in very chaste pointed style, and the windows of the aisles are nearly of the same character, only they are in pairs, separated by mullions. The chancel is of inferior architecture, and on the north side two of the lancet-shaped windows are built up; when seen without any screen of trees, this church has a modern air, which makes it look poor; but when viewed as in a grove it is much more imposing. The church of Bicker is richer, and for that reason more imposing; the tower especially is a fine piece of architecture. The nave and aisles contain windows in twos or threes, separated by mullions, and with a quatrefoil over. The chancel has a more modern appearance, the windows being square, and divided into compartments by mullions: the east end is strengthened by powerful buttresses, and the side walls by buttresses of inferior size. The whole has a rich appearance, but does not look very classical. We must now say a few words of the book, having dwelt for a considerable length upon its subject. The plates are, in general, tolerably well executed for so cheap a book, but several of them are out of drawing; the general getting up is, we are constrained to say, inferior; and the whole work is in a style which we do not exactly like, though it is perhaps the best that the artist could afford. For the style of the building the draughtsman is not accountable, as he is the copyist merely, and not the projector of the work. As we take it, however, it is a very creditable specimen of rural architecture.

ARCHITECTS, &c., IN AUSTRALIA.

Our correspondent P. Z., who writes in such flowing terms on the island at the antipodes which is at present the lion of British emigration projects, asks our opinion on the state of engineering arts in the country to which he alludes.

In reply to him we have briefly to say, that there is not in New Zealand scope for a single architect or other gentleman following any of the professions which are called scientific; and a considerable time must elapse before it can come to that state in which it can find room for any one entitled to any of the epithets we have mentioned. In our sense of the term, there is not among them even one individual who is entitled to the character of a tolerable engineer or surveyor. The reason of this is very obvious: the colonists have no employment for such gentlemen, even if they had them.

Engineeers and architects, in the sense in which these terms are employed by us, and such surveyors as use first-rate instruments, are required only in old countries, where there is a general development of all the sciences; and hence they would be out of character in a new country like Australia, in which, though the people are from an old country, the country itself is new. The surveyor who is required in Australia is merely one who can give a rough estimate of the surface of a field; for where land is of little value it would not pay for the expence of our engineering, as that operation done with nicety would cost as much as the fee simple of the ground itself. Architects, in our sense of the word, are still less needed; for though the people must have houses, we could not call them architectural ones. They are log-houses, as is still the case in the greater part of British America; and as long as a half or a third may be added to the estate for the expence of an architect's house, the people will be contented with the log-house of their own construction, the same as they are in Canada and the other parts of America which come under the denomination of new countries. Then, in our sense of the term, there is even less to do for engineers than for architects. Unless in countries where the people are under despotism in some of its forms, people never think of building or otherwise constructing public works until they have comfortable houses to dwell in. In this way the Architect is always greatly ahead of the Engineer; and as society must be considerably adorned before it calls in the Architect, so it must be much more adorned before it calls in the Engineer. A single family may have a great house built for them, but those families must be so united as to be a considerable nation before they want anything like engineering. The labours of the Engineer have pretty nearly the same relation to society as those of the Architect have to individual families; and before there can be such a society, the people must have lived a long time in the same land, and made it their fatherland, and not their place of mere sojourn, or inhabited by them as single men or individual families. This is the natural progress of society, a progress which may be accelerated, but cannot be dispensed with; and in this progress Australia has made scarcely any advance. Therefore, it is not a country for Surveyors, Engineers, or Architects, in our sense of the terms.

SCIENTIFIC SOCIETY OF LONDON.

The usual meeting was held on March 16th, when Mr. Charles Moxon submitted an interesting paper on a "Triune Classification of the various Productions of Nature," which, from his essay, might apparently be extended throughout the sciences. The *primâ facie* design of the paper was entirely derived from the natural system of classification, and the remarks of Professor Swainson on the circular arrangement of animals, &c.; but, in the extended view which this essay embraced, it appears that, as the analogies existed throughout nature, so the recognition of fixed types and subtypes

would provide, as it were, an alphabet for the study of the natural sciences collectively or individually. The essay was most explicit as regards the higher departments of natural productions, but from the remarks, we believe that the same system will eventually be traced as clearly in inanimate as animate bodies. This essay was followed by a lengthened and interesting discussion, which was adjourned to the meeting on April 6th. The Chairman announced the presentation to the Society of two Silver Medals, to be awarded by them for the best essays on the Electrotype and Phytography.

PREMIUMS.

An honorary Silver Medal will be awarded to the author of the best essay on the *Electrotype*—its application generally, and with especial reference to superficial extent; as also its peculiar advantages.

These essays to be sent in on or before July 1st, 1842.

An honorary Silver Medal will also be awarded to the author of the best essay on *Phytography* (either botanical, geological, &c.,&c.) *confined to any one district;* this award to be made with especial reference to the superiority of arrangement, and to the description of new or rare species.

These essays to be sent in on or before Oct. 1st, 1842.

The premiums will be awarded at the anniversary meeting in November 1842, and in order to give increased stimulus to students of science, the Society reserve to themselves the right of publishing such essays as may be considered of sufficient merit, independent of that for which the premium is awarded.

Further information can be obtained, by letter (post paid) or application to the resident sub-secretary, at the rooms of the Society, and the essays must be sent in on or before the dates specified, under cover to the Hon. Secretary of the Scientific Society of London. By order of the Society.

GEO. F. FORDHAM, *Hon. Sec.*

9, Gray's Inn Square.

PROFESSOR HOSKING'S LECTURES ON ARCHITECTURE.

ON Friday the 11th inst. Professor Hosking continued his course of lectures at King's College. He commenced by instancing the Palazzo Caprarola by Vignola, as a fine model of architectural composition, comparing it with a drawing of Inigo Jones's design for Whitehall Palace, a comparison unfavourable to the latter, which exhibited a multiplicity of parts and frippery contrasting most disadvantageously with the severe style and majestic simplicity of the Italian palace. The Professor next exhibited an elevation of the Farnese palace, in which the bold cornice, the string courses, rustic, and the general simplicity of the whole composition, amply atone for a few defects. He then proceeded to explain the general characteristics of the two styles of architecture—the horizontal and vertical. The Greek and Roman architecture and the pointed were based upon totally different principles; in the former, the leading lines of the building,—those which first strike the eye,—are horizontal; in the latter, perpendicular: the first does not necessarily include the arch; to the latter it is essential: the former requires an entablature over the columns; the latter knows no such member of the building: the former is divided into distinct orders, the different forms of which are confined to one, and incapable of being changed; while the characteristic parts of the other cohere harmoniously with each other; thus the enrichments of the buildings of the time of the Tudors may be made to cohere with the architecture of a preceding period. Architectural terms were often misapplied; he would propose to confine the word "Gothic" to that architecture which arose immediately upon the extinction of the Roman. The gradations were easily traced: first, the pure Greek style knew no arch: the Romans then introduced it, which in course of time was set upon the top of columns without entablatures, thus making columned arcades. There was an example of this in the old basilica of St. Peter's, at Rome. The Professor then produced a number of elevations, showing how the horizontal style gradually merged into the vertical. In the flank of old St. Peter's, at Oxford, the old Roman Gothic might be clearly traced in the horizontal arrangement of the arches; and the Castor Town at Norwich might afford another example of the same class. Old St. Peter's, Northampton, is a building in the horizontal style, but a story above, containing pointed arches, and the flanking buttresses, were later additions, and show the first tendency to a vertical arrangement. The professor then went on to caution the students to keep these two styles distinct, nor allow the mind to be occupied by more than one at a time, which he considered to be the fault of Inigo Jones in his design for Whitehall palace; and concluded by remarking how very few buildings exist in this country anterior to the Conquest but what may be considered Roman; that the pointed arch was of still later introduction; and that, though it had been asserted this was to be traced in Egyptian architecture, this assertion was founded on misapprehension of the mode of construction of their buildings, which he illustrated with two or three simple diagrams, showing that no such thing as an arch existed in them.

PROFESSOR HOSKING'S LECTURES ON ENGINEERING CONSTRUCTIONS.

MARCH 11.—The lecture this day was on the construction of bridges. When a river was to be crossed, a suitable point must be selected: the narrowest part was not always the most suitable, for it was necessarily the deepest, and, unless for single-arch bridges, a wider and shallower part might often be preferable. The bridge should be erected in a straight part of the river, as this would then present a more uniform section. The ground on which the bridge was built, was a most important point; a soil liable to be acted on by the running water was obviously a dangerous support for it. Thus Old London bridge was nearly thrown down by the undermining of its foundations, when several of the centre arches were thrown into one, and the scour of its bed thereby increased. The drainage of the country above was often injuriously interfered with by bridges; old London bridge prevented the proper drainage of the low-lying parts of London; and destructive inundations were very common in France, in consequence of the obstruction caused by bridges; the dreadful flood which lately occurred at Lyons, was an example of this. In surveying a river, for the purpose of building a bridge, a longitudinal section should be made in addition to the cross section; and if the bed of the river near the bridge presented any unevennesses, or deeper parts, the substruction of the bridge should be carried down to a corresponding depth. The highest and lowest points of water, if a tidal river, should be ascertained, and inquiry should be made into the highest point the water had reached in times of floods; buildings in old countries, and even trees and bushes near the bank in new countries, or those which were thinly peopled, often preserved records of these in matters drifted against them, and there retained. The professor then went on to speak of the approaches to bridges: in country roads, it was not worth while to incur very great expense in the formation of these, but they ought never to exceed the average inclination of the hills on the line of road. A gross blunder in this particular had been made in building Blackfriars and Westminster bridges: instead of the *average* inclination of the adjacent streets, the very *steepest*, viz. Holborn Hill, had been selected, which was most absurd. Nevertheless, nearly all the first designs for New London Bridge, Mr. Telford's among the number, assumed the same preposterous and dangerous inclination. As to the question, whether a bridge perfectly level was preferable to one with a trifling inclination, it could hardly be considered settled; the late Mr. Telford preferred the latter. The Professor concluded his lecture with some remarks on the construction of wooden bridges, elucidating them with diagrams of the various modes of strengthening them, when the bearings were too distant from each other, and observing that a wooden bridge ought to be as much as possible independent of iron, by accurate framing and trenailing together.

MARCH 15.—This day the Professor continued the subject of wooden bridges, explaining the manner in which these are sometimes built on the principle of the arch. A church at Venice is surmounted by a wooden cupola of considerable dimensions, and not exceeding five inches in thickness, formed in this manner. Sometimes the roadway is suspended from an arch of this description, instead of being placed upon it, as in bridges of masonry; and this plan of construction possesses many advantages, especially where timber is cheap. (This was explained by diagrams.) The old timber bridge over the Rhine at Schaffhausen was a remarkably well-constructed bridge in many particulars: a model of it, on a large scale, was now in the Museum of King's College. Timber bridges, and especially the piles, were of course subject to decay, and iron was not a suitable material for piles, but in some cases wooden piles, cased watertight with iron, might be

advantageously used. Before concluding the subject of timber bridges, he would warn the students not to follow the example of the Americans in attempting to introduce into them architectural decorations in the semblance of masonry. Nothing could be in worse taste, a remark which applied to all decoration out of character with the material employed. The Professor then went on to direct the attention of the students to suspension chain bridges. The mode of their construction was well known, but he would mention at the outset an error often fallen into by persons who did not understand their principle, viz. forming a more acute angle with the chains on the land or fixed side of the abutments than on the side of the bridge, thereby subjecting them to a lateral, instead of a merely vertical pressure. An error of this kind had been made in constructing the landing-pier near Battersea Bridge. One great fault in the principle of these bridges was, their great liability to injury by the expansion of the metal, the whole effect of which was thrown into the roadway, thus alternately elevating and depressing it. Suspension bridges too, were often much damaged by violent gales of wind, the Montrose bridge and the Brighton pier for instance: this was caused by the regular vibrations induced by the vast span and want of rigidity. The Professor concluded by observing, that the occasionally unavoidable unequal bearing on the different chains was another source of destruction in these bridges, and though iron in large bars was not so strong as the same quantity divided into several smaller ones, yet on the whole he was not sure that it would not be better to construct them with a single pair of chains, instead of several parallel ones, as was the usual mode.

March 18.—The Professor this day continued the subject of bridges. These were frequently erected in connexion with masses of earthwork, especially on railways, but it was a maxim that the bridge should stand independently of the earthwork; this rendered necessary the use of reversed arches, counterfort walls, &c. The bridge-builder must be careful not to overload the haunches of his bridge, or they would be liable to be crushed in. This was an error often fallen into in the construction of bridges, the span of which was a large segment of a circle, and to obviate this evil, large circular apertures were sometimes left, to lessen the weight pressing on the haunches. The late Mr. Telford attained the same object by supporting the roadway on spandrel walls, but Rennie improved on this construction in Waterloo and London bridges, by inverted arches over the piers connecting the haunches of the main arches. After some remarks on the use of landings or of arches to carry the roadway, the Professor, in recommending the adoption of single-arched bridges, wherever practicable, as obviating the necessity for piers in the waterway, which were always an evil besides the enormous expense of building them, went on to observe, that the limit of space to which a granite arch might be carried, was hardly yet known. The span of the arches of the brick bridge on the Great Western railway, was 128 feet, with a rise of 24½ feet, and when it was considered how superior was granite in bearing a crushing force to brick, or rather to the cement between the courses, (for in courses of granite, properly put together, there was no more cement than necessary to fill up the inequalities of surface,) there could be no doubt that bridges of this material might be safely built of much greater span than any now existing. Where piers were indispensable, however, they might be made much smaller than they usually were, and thus form less obstruction to the water-way. The maxim of the old bridge-builders was, that every pier ought to be strong enough to support the arch, or be its own abutment; but this was most absurd—no single arch in a series would have to stand unsupported by its neighbours on the right and left, why then build it as though it would? As a general rule, he would say, that the piers of a bridge need not be of greater thickness than double that of the springing stones of the arch. The bridge at Neuilly, near Paris, by Perronnet, who set the first example of reducing the preposterous size of piers, was a very light and graceful structure, in consequence of this mode of construction—a quality in which it excelled many bridges which had been built since.

March 22.—The class attended to day at Westminster Bridge, for the purpose of inspecting the coffer-dam now erected there, and afterwards went over the buildings now in progress for the New Houses of Parliament. The Professor briefly explained the mode of construction of the coffer-dam. The one they were in was constructed round the western pier of the central arch of the bridge; the piles composing it were driven through the stratum of gravel, in that spot from 10 to 12 feet thick, and several feet into the clay below it. At high tides there was from 25 to 30 feet of water pressing against it, and it was consequently necessary to strengthen it, by struts of balk timber against the pier. He then proceeded to observe on the repairs now going on to the bridge. This, as he pointed out, was originally built in a very defective manner, the work, too, was very ill put together, the bonding was very imperfect, and large spaces were frequently left between adjoining stones, which were filled up with pieces of stone and even with wood chips. The piers of the bridge were originally built in caissons, but owing to the imperfect grounding of the caissons and to the scouring of the gravel from under them, one of them had sunk nearly three feet, and the remnants of the caisson were found dispersed round it, the ends of the timbers tilted up, and distorted in a most extraordinary manner. In consequence of this, as is well known, the two arches adjoining the pier were taken down shortly after the completion of the bridge, and two additional courses of masonry about three feet in height built upon the pier, in order to reach the springing level. (Drawings illustrative of the appearance of the caissons, and of the mode adopted to underpin the work, were exhibited to the students.) The repairs now going on were executed in a most complete and satisfactory manner. All the unsound part of the piers was taken out and replaced, they were underpinned, their base was considerably extended, and they were surrounded by sheet piling, driven deep into the clay, as to preclude the possibility of any further injurious action of the water upon the stratum of gravel under them. This sheet piling was admirably fitted together; the point of a penknife could not be introduced between the piles. The Professor then proceeded to explain the manner in which the arch stones were replaced. The defective stone was easily hacked out, but it was obviously impossible to replace in it one piece, as the larger end would have to go in first: it was, in fact, introducing a wedge by the broad end. The difficulty was met in this way: Two stones were prepared, one a horizontal slab, of the exact width, and about a third of the thickness of the cavity left by the displaced stone, and the other wedge-shaped, of a size and form to fill up the remaining part of it, and holes corresponding to each other were made in each for the reception of a joggle. The wedge-shaped stone being first introduced, the rectangular one was placed upon it, and when it had reached its proper position, the joggle, which had been previously held up by a string passing through a small hole drilled in the upper stone, was allowed to fall into the cavity prepared for it, and the two stones were thus firmly bolted together. After minutely examining every part of the interesting operations going forward, the students proceeded to the New Houses of Parliament, where the Professor entered into many details respecting the works, and the materials employed, which hardly admit of a connected report. The class will meet again on Friday, the 8th of April, after the Easter holydays.

GEOLOGICAL NOTICE OF THE DISTRICT OF MANCHESTER.

BY E. W. BINNEY, ESQ.

The geology of Manchester and its vicinity has perhaps been less investigated than that of any other large town in the kingdom; this assertion may appear extraordinary, when we consider how much our town owes to the mineral treasures of the earth for its commercial importance; but to all who are conversant with the subject it will be admitted to be perfectly true. Manchester is situated on a part of that extensive deposit of drift, or diluvium, which covers from our view so great a portion of the strata of the midland and north-western counties of England, skirting the sides of the Penine chain, and enveloping the lower tracts of country. The appearances presented by this deposit are very variable—at one place it being composed of a coarse gravel; at another, of a stiff clay mingled with pebbles; and elsewhere, consisting of a fine forest sand. It is only on the great lines of drainage, or in artificial sections, that a view of the substrata is to be obtained. The rock underlying the area of the town of Manchester is the upper new red sandstone—the second member in the descending order of the formation of that name. This formation occupies a considerable part of England, and is chiefly remarkable from its overlying our true coal-fields (most of which disappear under it), and from its containing those valuable mines of salt and gypsum, for the former of which the neighbouring county of Chester is so famous. The country to the north-west, north, and east sides of Manchester gradually rises to a considerable elevation above the site of the town; it is traversed by three valleys, along which flow the Irwell, Irk, and Medlock. These three rivers unite at Manchester, and, after a course of ten miles, fall into the Mersey at Irlam Green; thence the river winds its way along the new red sandstone plains of South Lancashire and Cheshire into the Irish Sea. The extent and depth of the valleys through which these rivers flow, generally indicate the geological features of the country; and it is in them that we find the only true natural sections. Of these valleys, that of the Irwell is by far the most extensive; for the distance of five miles it is occupied on the south-west side by the carboniferous strata, and on the north-east by the upper new red sandstone. Those of the Irk and Medlock are of much less extent, being chiefly in the vicinity of the town through the coal measures; but, whenever they touch upon the new red sandstone their width visibly increases. The strata com-

posing the new red sandstone formation, in this neighbourhood, may be conveniently divided into the following descending order:—1. The upper red marls. 2. The upper new red sandstone. 3. The red and variegated marls with magnesian limestones. 4. The lower new red sandstones. The whole of these deposits are very rarely, if ever, seen together; the upper marls having frequently been removed by denudation, and the upper sandstone overlying the two inferior strata. But in one or two places we find the two last entirely wanting, and the upper sandstone resting on the carboniferous strata. To a superficial observer, the only rock occurring in this neighbourhood would appear to be the upper sandstone; the lower marls and lower sandstone being only seen in one or two places at the surface; coal-sinkings and boring for water, however, generally prove their existence.—*Trans. Manchester Geological Society.*

MISCELLANEOUS.

Consumption of Smoke.—We are happy to learn that, in consequence of the perfect success of Mr. Samuel Hall's patent apparatus for the consumption of smoke, as applied to the *Bee* locomotive-engine on the Midland Counties Railway, the directors of that company are applying it to another of their engines, the *Wolf*, which will be ready in a few days. It was put to the *Tame* locomotive about a week ago, and is now in daily operation on the Birmingham and Derby Junction Railway. Its accurate consumption of smoke is highly interesting, and deserving of the inspection of the scientific world.—*Derby Reporter.*

Improved Steam-Engine.—Messrs. Rennie have just completed the erection of a steam-engine on the Hornblower and Woolf principle—two cylinders—one working with high-pressure steam as it issues from the boiler, and the other a low-pressure, using the steam as it issues from the cylinder, which it then expands five times, consuming only between 2 lbs. and 3 lbs. of fuel per horse-power, or about one-third of the usual quantity. The qualities of this engine have been tested in the presence of several scientific men, when it was found that on a trial of eleven working hours it consumed at the rate of 132 lb. of coal per hour, the engine then exerting an effective working power of sixty horses; this was at the rate of only 2·2 lb. per horse-power per hour. The water required for condensation was only about one-third of the usual quantity. The duty, taken in Cornish measures of 94 lb. of coal per bushel, was equal to 85,000,000 lb. raised one foot, or upwards of 101,356,768 lb. raised with one cwt. of coals; in the performance of this duty the engine averaged nineteen strokes per minute. It is a reciprocating rotary engine, and owes its great superiority to judicious proportions and superior workmanship.

The Acarus Galvanicus.—In the autumn of 1837 the scientific world were greatly excited by the announcement that Mr. Crosse, of Broomfield, had observed insects, of a previously unknown species, come into being among certain voltaic arrangements. Among the various objections urged against their connection with the electricity was the possibility of ova being in the atmosphere. At the Electrical Society, on Tuesday last, a paper was read from Mr. Weekes, of Sandwich, describing experiments wherein he had obtained the same species of insect in a close atmosphere over mercury. Every possible precaution was taken to exclude extraneous matter, into the detail of which we shall not enter. On the 3d of December, 1840, operations commenced; at the latter end of October, 1841, the first insect was seen; on the 25th of November five were detected. Since that period they have been frequently examined. The account contains several interesting incidents with respect to the habits of these strangely produced creatures. Simultaneously with the experiment just detailed another apparatus was put in action in an atmosphere of oxygen gas; on the 26th of February 1842, eight or ten full-grown acari were observed in vigorous locomotion. The solution whence these insects appear to have emerged was one of silicate of potass, made with materials that were transferred from a furnace heat to boiling water, and filtered under cover.

The Soho Patent Candlestick.—One of the most useful inventions for domestic purposes recently brought forward is that designated "The Soho Patent Candlestick;" of which specimens in plate and in Britannia metal have been already manufactured at Soho, in Staffordshire, and at Sheffield. It is described as applicable to every description of candleholder, whether for the drawing-room, library, office, kitchen, or chamber; and may be manufactured in any material, and in the very plainest or most ornamental form, while the saving of candles in a single year will, it is said, pay the trifling additional cost of the article a dozen times over. This invention is intended to, in fact, act as a sort of complete save-all, for it obviates the necessity of wasting any part of a candle, by merely turning round the nozzle, horizontally—and so gradually raising the candle until every particle of tallow is consumed. It is greatly preferable to the old fashioned slide, which frequently becomes clogged, and in using which the candle is liable to be pushed out. Another advantage is the simplicity of the action, and the almost impossibility of getting out of repair. Besides which, the nozzle is cleaned easily and safely by taking out the candle and immersing it in a little hot water. The idea, we believe, originated with Mr. Lee Stevens, who is well known to the public in connection with several useful undertakings.

Coal.—Among the recent geological discoveries is that of the superior quality of coal found to be procurable at Borneo. The honourable Company's steamer Diana had brought over several specimens, and from all accounts there is every prospect of an abundance of the mineral being obtained in that quarter. A coal formation is found on Pulo Cheremin, an island at the embouchure of the Borneo river, extending along its coast, and running out towards the sea, by which it is covered at high water, and also taking a direction inland; but to what depth or extent has not as yet been ascertained, although manifestly considerable.

Atmospheric Railway.—The report on this subject of Sir F. Smith, R. E., and Professor Barlow, has lately been presented to Parliament. The summary of their opinions is thus given:—"1. That we consider the principle of atmospheric propulsion to be established, and that the economy of working increases with the length and diameter of the tube. 2. That the expense of the formation of the line in cuttings, embankments, bridges, tunnels, and rails will be very little less than for equal lengths of railway to be worked by locomotive engines, but that the total cost of the works will be much greater, owing to the expense of providing and laying the atmospheric tube, and erecting the stationary engines. 3. That the expense of working a line on this principle, on which trains are frequently passing, will be less than working by locomotive engines, and that the saving thus effected will, in some cases, more than compensate for the additional outlay; but it will be the reverse on lines of unfrequent trains. However, there are many items of expense of which we have no knowledge, and can form no opinion, such as the wear and tear of pistons, valves, &c.; on these further experience is needed. 4. That with proper means of disengaging the train from the piston in cases of emergency, we consider this principle as regards safety equal to that appertaining to rope machinery. There appear, however, some practical difficulties in regard to junctions, crossings, sidings, and stoppages at road stations, which may make this system of less general application."

Brick-making, &c.—A discovery has been made by Mr. R. Prosser, of Birmingham, which bids fair to be attended with important results to the interests of architecture. The novelty of Mr. Prosser's process consists in the clay being dried, ground to powder, and submitted to pressure in metallic moulds, until the particles cohere together. As there is no water in combination with the clay, no drying process is necessary; consequently, the articles made by this method are ready to be fired or burned as soon as they leave the machine. Owing to the great pressure required to cause the particles of clay to cohere together, the articles made by this press have greater density than those made in the ordinary way; they are also less porous, and not subject to decay in wet or frost. In addition to these advantages, any architectural device may be impressed upon the clay, which, when burnt, will retain all the sharpness of the original, however elaborately finished. By this process bricks may be made in all weathers, and with greater economy than by any other plan known at present. The brick-press is worked by hydraulic pumps, giving about 300 tons pressure, thus producing the adhesion and cohesion. The machine delivers the brick (four at a time in the present machine) ready at that instant for the kiln, requiring no exposure to the atmosphere to dry. The whole operation, from the time of putting the powdered clay into the machine to the delivery of the brick, occupies about half a minute. Machinery might readily be constructed to produce bricks fifty a minute.

LIST OF PATENTS.

Continued from page 64.

(SIX MONTHS FOR ENROLMENT.)

William Newton, of Chancery Lane, civil engineer, for "certain improvements in regulating the flow of air and gaseous fluids," being a communication.—Sealed February 25.

Osborne Reynolds, of Belfast, Ireland, clerk, for "certain improvements in covering streets, roads, and other ways with wood, and also in the means of enabling horses and other animals to pass over such roads and

other slippery surfaces with greater safety than heretofore."—Sealed February 25.

John Birkby, of Upper Rawfold, York, card manufacturer, for "improvements in the manufacture of wire cards."—Sealed Febraary 25.

William Saunders, of Brighton, gent., for "improvements in apparatus employed in roasting and baking animal food."—Sealed February 25.

Samuel Morand, of Manchester, merchant, for improvements in machinery or apparatus for stretching fabrics."—Sealed February 26.

Marc la Riviere, of London Fields, Hackney, gent., for certain improvements in the machinery for figure weaving in silk and other fabrics."—Sealed March 1.

Thomas Smith, of Northampton, plumber, for "an improvement or improvements in water-closets."—Sealed March 1.

George Carter Haseler, of Birmingham, jeweller and toy maker, for "improvements in the tops of scent-bottles."—Sealed March 3.

Edward Slaughter, of Bristol, engineer, for "improvements in the construction of iron wheels for railway and other carriages."—Sealed March 4.

James Clements, of Liverpool, manufacturer of toys, for "improvements in composition for ornamenting glass and picture frames, and articles for interior and other decorations, also for the manufacture of toys and other fancy articles."—Sealed March 4.

William Palmer, of Sutton Street, Clerkenwell, manufacturer, for "improvements in the construction of candle lamps."—Sealed March 4.

William Palmer, of Sutton Street, Clerkenwell, manufacturer, for "improvements in vessels for making infusions or decoctions, and for culinary purposes, and in apparatus for measuring or supplying from vessels."—Sealed March 4.

John Green, jun., of Newtown, Worcester, farmer, for "certain improvements in machinery or apparatus for cutting or reducing turnips, mangle-wurzle, carrots, and other roots for food for horned cattle, horses, and other animals."—Sealed March 7.

John George Bodmer, of Manchester, engineer, for "certain improvements in machinery or apparatus for cleansing, carding, roving, and spinning cotton, and other fibrous substances."—Sealed March 7.

James Readman, of Islington, gent., for "a certain improvement or improvements in the barometer."—Sealed March 7.

John Duncan, of Great George Street, gent., for "improvements in machinery for excavating soil," being a communication.—Sealed March 7.

John Warrick, of Lawrence Pountney Lane, London, merchant, for "an apparatus called a gasoscope, and intended to show the presence of bi-carburetted hydrogen gas (the gas used for lighting) in mines, wells, houses, buildings, rooms, or vaults, and consequently to prevent the explosions and accidents liable to be produced by the said gas."—Sealed March 7.

Francis Kane, of Cumberland Street, Middlesex Hospital, mechanic, for "improvements in the construction of fastenings for the parts of bedsteads and other frames."—Sealed March 7.

Sir Francis Desanges, of Upper Seymour Street, Portman Square, Knight, and Anguish Honour Augustus Durant, of Long Castle, Shropshire, esq., for "improvements in apparatus for sweeping and cleansing chimnies or flues, and extinguishing fires therein, which they intend to call ramoneur."—Sealed March 7.

Robert Frampton, of Cleveland Street, Fitzroy Square, coach-maker, for "improvements in the construction of hinges."—Sealed March 7.

Henry Barron Rodway, of Birmingham, wine-merchant, for "improvements in the manufacture of horse shoes."—Sealed March 7.

Thomas Henry Russell, of Wednesbury, Stafford, iron tube manufacturer, and Cornelius Whitehouse, of the same place, for "improvements in the manufacture of welded iron tubing."—Sealed March 7.

William Newton, of Chancery Lane, civil engineer, for "an improved machine or apparatus for weighing various kinds of articles or goods," being a communication.—Sealed March 7.

Thomas Hedley, of the town and borough of Newcastle-upon-Tyne, gentleman, and Cuthbert Rodham, of Gateshead, Durham, millwright, for "an improved apparatus for purifying the smoke, gases, and other noxious vapours arising from certain fires, stoves, and furnaces."—Sealed March 8.

William Catford, of Chard, Somerset, mechanic, for "certain improvements in machinery or apparatus for making or manufacturing lace or other netted fabrics."—Sealed March 8.

Henry Smith, of Liverpool, engineer, for "improvements in the construction of wheels and breaks for carriages.' —Sealed March 10.

Richard Beard, of Earl Street, Blackfriars, gentleman, for "improvements in the means of obtaining likenesses and representations of nature and of other objects."—Sealed March 10.

William Edward Newton, of Chancery Lane, civil engineer, for "certain improvements in boilers, furnaces, and steam engines," being a communication.—Sealed March 10.

Charles William Firchild, of Weoley Park, Northfield, Worcester, farmer, for "an improved propelling apparatus for marine and other purposes." Sealed March 14.

Reuben Partridge, of Cowper Street, Finsbury, Middlesex, engineer, for "certain improvements in machinery or apparatus for splitting and shaping wood into splints for the manfacture of matches and other similar forms."—Sealed March 14.

Alfred Green, of Sheffield, surgical instrument maker, for "certain improvements in trusses or surgical bandages."—Sealed March 15.

Edwin Ward Trent, of Old Ford, Bow, rope maker, for "an improved mode of preparing oakum and ohter fibrous substances for caulking ships and other vessels."—Sealed March 21.

Sydney Jessop, of Sheffield, merchant, for "an improve dmode of preparing wrought iron, intended for wheel tires, rails, and certain other articles."—Sealed March 21.

Zachariah Parkes, of Birmingham, manufacturer, for "certain improvements in apparatus for grinding and dressing grain, wheat, and other grain."—Sealed March 21.

John Clay, of Cottingham, York, gentleman, and Frederick Rosenberg, of Sculcoates, gentleman, for "improvements in arranging and setting up types for printing.—Sealed March 31.

William Hancock, of Amwell Street, Middlesex, for "certain improvements in combs and brushes.—Sealed March 21.

Edward John Dent, of the Strand, chronometer maker, for "certain improvements in chronometers and other time keepers."—Sealed March 21.

William Brockedon, of Queen's Square, Middlesex, gentleman, for "improvements in manufacturing fibrous materials for the cores of stoppers to be coated with India rubber, and used for stopping bottles and other vessels."—Sealed March 21.

John Haughton, of Liverpool, clerk, for "improvements in the method of affixing certain labels."—Sealed March 21.

William Palmer, of Sutton Street, Clerkenwell, manufacturer, for "improvements in the manufacture and preparation of pills, and some other articles of a medicinal or remedial nature."—Sealed March 21.

Mark Freeman, of Sutton Common, Surrey, gentleman, for "improvements in the construction of inkstands."—Sealed March 21.

Robert Hazard, of Clifton, Somerset, confectioner, for "improvements in apparatus for heating public and private buildings."—Sealed March 21.

Moses Sperry Beach, of Norfolk Street, Strand, printer, for "improvements in machinery used for printing with type, and in the construction of type for printing," being a communication.—Sealed March 23.

NOTICE.

Those gentlemen who have made inquiries as to whether it is our intention to treat of mining subjects, and of machines, are respectfully informed that such is our intention; and every article on these subjects, or indeed on any subject connected with the more useful arts, shall meet with due attention.

We have to apologize to several gentlemen whose books, notwithstanding their value, we have neither time nor space to notice as they deserve. In the first place, there is the Papers of the Corps of Royal Engineers, a collection which we ought to have mentioned ere now; secondly, a Treatise of Marine Surveying and Hydrography, by Mr. David Thomson of Edinburgh, a highly talented engineer, and eminently qualified for writing on such a subject; thirdly, a Treatise on Land surveying and Levelling, by Mr. Henry James Castle, which is an excellent work on the general subject, and well adapted for young surveyors, to whom it is a perfect vade-mecum to their whole profession; fourthly, a Letter on the Improvement of Land, and the Conservation of manure, addressed to Philip Pusey, Esq., M.P., by Mr. James Bailey Denton, Surveyor, which places in a very striking light the means of increasing farm produce to a very great extent. All these works are most valuable in their several departments; and we shall endeavour to do justice to them in our next.

Our readers will perceive that we have given them a list of private bills before the House of Commons, the details of which we shall notice at length as occasion requires.